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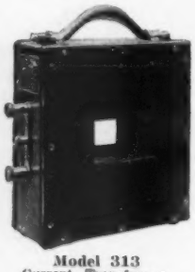

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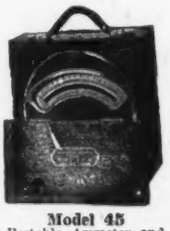

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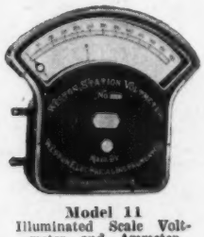

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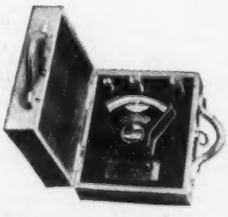

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A More Powerful N. E. L. A.

THE reorganization of the National Electric Light Association begun under the able leadership of President Ballard is going on apace. Geographic divisions have been established throughout the country, and the staff at headquarters is organized for prompt and intensive service. It was early realized that if the enlarged work of this important association was to be done effectively, ample funds must be available, and steps to that end were taken at the recent convention at Pasadena. The greatest step forward, however, aside from the provision for geographic divisions, was the formation of the Public Relations Section; the work of which should fill a long-felt want in focusing the attention of executives on the major questions of finance, regulation, management and public relations. Too long has the association neglected these vital topics. Fortunately, the chairmanship of the section has been intrusted to J. E. Davidson of Omaha, who not only possesses abundant energy and enthusiasm but is also well versed and experienced in the management of properties both small and great in many sections of the country. Under his guidance this section should give a good account of itself. The record also of President Ballard is being maintained by President-elect Martin J. Insull, and already there is a fast growing recognition of the prowess of the reinvigorated N. E. L. A. Although active work under the revised constitution and by-laws has only begun, the results so far amply justify the prediction that the National Electric Light Association will be more than ever the dominating organization of the industry.

Water-Power Development

ANNOUNCEMENT had hardly been made that the President had signed the water-power bill before applications began to be filed for licenses aggregating more than 500,000 hp., notwithstanding that the Federal Power Commission is not yet organized. This indicates how vital the interest is in water-power development. The country is in need of all this power, and by the provisions of the act the licensee must commence construction on the project within two years of the date of his license. An outlay of more than $200,000,000 will be necessary before the power is available, and it is futile to deny that such a large sum of money will not be readily forthcoming at reasonably low rates at this time. Such being the case, electrical energy from these sources will not be cheap as we have been wont to measure cheapness. The days for cheap power have gone. If located favorably, these water-power developments should find a ready market for all the energy, and certainly the ever-increasing cost of fuel and labor will render them more and more valuable as time goes on. This consideration as well as the provision of the act for maintaining the integrity of the investment should make water-power securities more attractive than they might otherwise be. Being optimists, we naturally look to see millions of water horsepower developed within the next few years. Production of electricity in the United States has for a long time been too near the peak, and the output has been too meager for the manifold new uses asking to be served. Nothing short of a tremendous increase in the output from sources other than coal-driven stations will avail much.

Prosperity Must Be Mutual

POWER is the lifeblood of industry. Without it factories must close their doors, middlemen sit idly in their offices, and all the complicated machinery of modern business come to a halt. It is therefore not strange to find more than sixteen thousand business men of Illinois represented in an appeal to the Public Utilities Commission of that state to give immediate relief to its utilities in the shape of higher rates. Just as business men are willing to pay higher transportation rates rather than have the arteries of commerce cease to function, so they are willing to pay more for power rather than have its supply restricted because it no longer pays for its generation. It is not a special tenderness for the electrical utilities that prompts them, but self-interest and a recognition of facts.

Money at 8 per Cent

EIGHT per cent, long the real rate of interest borne by many public securities issued at a nominally lower price, has at last received frank recognition in the money market through the issue at that rate of $2,000,000 ten-year gold bonds by the Idaho Power Company. It is obvious that a utility paying 8 per cent and selling its bonds at par pays no more than one paying 6 or 7 per cent and able to sell securities only at a discount equivalent to the difference between the lower and the higher rate. Under the new method a clearer object lesson is given to the public and the commissions, and should the example be widely followed, the effect in obtaining essential rate increases should not be small.

The Fuel Situation

OLD KING COAL is once more playing his unapplauded part on the nation's industrial stage. The threatened shortage is no bogie, but a very real peril. If shutdowns of utilities and factories, with great public inconvenience, widespread suffering and heavy financial losses, are not to ensue, every effort must be made to speed up production and transportation. First and foremost the utilities must be relieved from the peril of hand-to-mouth—perhaps we should rather say car-to-furnace—supply and enabled to accumulate

adequate storage reserves. The Interstate Commerce Commission will surely see the wisdom of granting to them the priority that, on the northern Atlantic seaboard at least, has become a public necessity.

The Stabilizing Effect of Reactors

TWO highly important papers were read at the A. I. E. E. convention this week dealing with the problem of assuring stable operation of high power generating systems in case of short circuit. The papers were presented by R. F. Schuchardt and by Dr. C. P. Steinmetz and are based on the investigation of a startling example of instability which occurred last September on the system of the Commonwealth Edison Company. It is needless here to go into the detail of the series of accidents which conspired to the general result, which was the dropping of substantially the whole 25-cycle load of 200,000 kw. followed by violent hunting of the units for almost a quarter of an hour before synchronous operation was fully restored. In the stations concerned the generators are, with a single exception, provided with reactors of moderate capacity in the phase leads, and part but not all of the tie lines and bus sections are also provided with reactors. The feeders, however, were not so provided, and the result of this omission proved serious.

In brief, there were two extremely violent short circuits, both from cable failures very close to the busbars, with the result of dropping the voltage far below the point where the synchronous load could stay in phase. The lost load caused the generators to speed up, and as the governor control was resumed the various units, reacting at different rates, were left hunting for synchronism until by clearing tie lines and treating the situation in detail order was gradually restored and the machines steadied down to pulling together. Our readers will find the exact report of the sequence of affairs extremely instructive as showing what may happen even in an exceedingly well-designed and remarkably well-operated generating system like that involved.

Dr. Steinmetz worked out some numerical examples showing the exact effect of short circuit under accurately defined conditions corresponding in general with the problem as presented in Chicago. Without feeder reactors the voltage, beaten down by short circuit, rises slowly, and it is pretty certain that all the synchronous apparatus will go out. Some delay will then ensue in getting it back into service. The strain, too, upon the circuit breakers is terrific. A feeder reactance of quite practicable value would greatly reduce the short circuit to be handled by the breakers, would hold the terminal voltage to at least half its normal value and probably save most of the synchronous operations. Dr. Steinmetz shows that even in the fraction of a second before the circuit breaker can possibly operate machines of different types drift apart by greater speed difference than allows their being pulled back into synchronism, and even with indentical machines variation in governing may produce the same effect.

In general terms, if sufficient reactance is available to limit the voltage drop on the generators to 50 per cent or less, these will probably remain in synchronism even through the period of governing, and if reactors are installed in the feeders sufficient to prevent such an initial drop of voltage, the chances are that all the synchronous apparatus will stay at work and come through the period of recovery to normal voltage without serious hunting. Incidentally Dr. Steinmetz has suggested that a strategic change of connections as between the various stations involved may produce a good effect by lessening the danger of a short circuit heavy enough seriously to cripple a large part of the generating capacity.

The whole subject is an exceedingly practical one, and the thanks of the profession are due to Mr. Schuchardt and Dr. Steinmetz for so full a discussion of a singularly instructive, if also destructive, example.

Considerations in Joint Pole Construction

CONSTRUCTION specifications and operating and legal agreements for joint pole construction have for a long time been a source of discussion and often unending controversy between telephone, telegraph, street-railway and central-station companies and other agencies using such devices. In many instances the disagreements have been so great that each company has decided to set independent poles for its own lines. In other instances state or municipal authorities, influenced by the seeming impossibility of an agreement being reached between disputing companies, have enacted laws preventing or limiting joint pole construction. In other places the practice of using joint poles has been considered dangerous to the public and has been forbidden on that account. We find throughout the country a multitude of practices, most of which are not the result of unprejudiced and sound thinking, but simply the fortuitous product of haphazard methods.

Those concerned in pole-line construction should realize that this state of affairs cannot last much longer. The public is fast getting to the point where it will demand still more careful scrutiny of the methods of operation of those companies that serve it. Public sentiment is being directed rapidly toward enforcing conservation, and there is no practice more obviously to be questioned from that standpoint than the practice of erecting several pole lines along the same route. Public authorities, commissions and other regulating bodies will soon be required to formulate more adequate regulations for joint pole construction and the companies interested must be prepared to present adequate suggestions. It would be unfortunate indeed if misdirected action were to delay the adoption of the desired standard practice.

To solve the problem adequately action from the national engineering societies and full co-operation from operating companies are needed. All the good that has been incorporated in existing agreements must be preserved, the public safety must be safeguarded, and all waste and unnecessary cost that the public in the end must pay must be eliminated. General principles that can be applied in the great majority of cases must be set down, and these must be in such form that most companies cannot fail to subscribe to them. Operating companies must realize that action to prevent pole wastage will be forced upon them in the near future by public sentiment. Their own welfare and the public welfare will be safeguarded only by immediate, unprejudiced and serious consideration of this important problem.

Education and Square Dealing Emphasized

PUBLIC utility operators are awake to the necessity of meeting the public they serve on a basis that will leave no room for suspicion or misunderstanding. Too long has the industry suffered from a policy of concealment when no concealment was necessary. Trite as this may seem, M. H. Aylesworth, executive manager of the National Electric Light Association, had occasion to dwell on it in his outline, made before the North Central Electric Association, of the work of the National Electric Light Association and its relation to the geographic section work. That men concerned in actual operating work and in the direction of association work should display the enthusiasm evidenced at Minneapolis means much for the future of the industry in that section and much for the future work of the N. E. L. A. because of its indication that the men who must speak for the industry are thoroughly alive to the trend of development in their field.

Relative Merits of Excitation Systems

THE exciter equipment of central stations has gone through many phases as the art has developed. In the beginning a directly belted or, later, directly connected exciter for each generator was a common device. As stations have grown in output and auxiliaries have multiplied, as in steam-driven plants, the tendency toward a separately driven excitation system has increased, the same units being used to supply excitation and auxiliaries.

The merits and demerits of the four systems—the central separately driven exciter, the direct-driven exciter applied to the general system, and the directly connected and separately driven exciters applied to individual units—were presented before the convention of the American Institute of Electrical Engineers by J. T. Barron and A. E. Bauhan this week.

In efficiency and facile operation the independent exciting plant has obvious advantages. It is, however, subject to some inconvenience, like any other general scheme, when used for purposes aside from pure excitation. In principle a separately driven exciter for each unit gives the greatest degree of reliability. Its cost is greater than that of the other systems and its efficiency in units of moderate size is less; but it possesses a high degree of independence. In case this plan is used it can be associated with other individual exciters for the power supply of auxiliaries. Its disadvantages diminish with the size of the unit and in case of very large turbo-generators are minimized. As regards general reliability, the authors of the paper referred to rate it high despite its additional cost and the requirement of extra space. Closely following it and sometimes more desirable is the independently driven general excitation plant composed of a sufficient number of units to secure continuity of service. Preferably such a system is driven by independent prime movers, although sometimes motor-driven units by the main busbars may be well employed at the cost of certain rather remote possibilities of serious trouble.

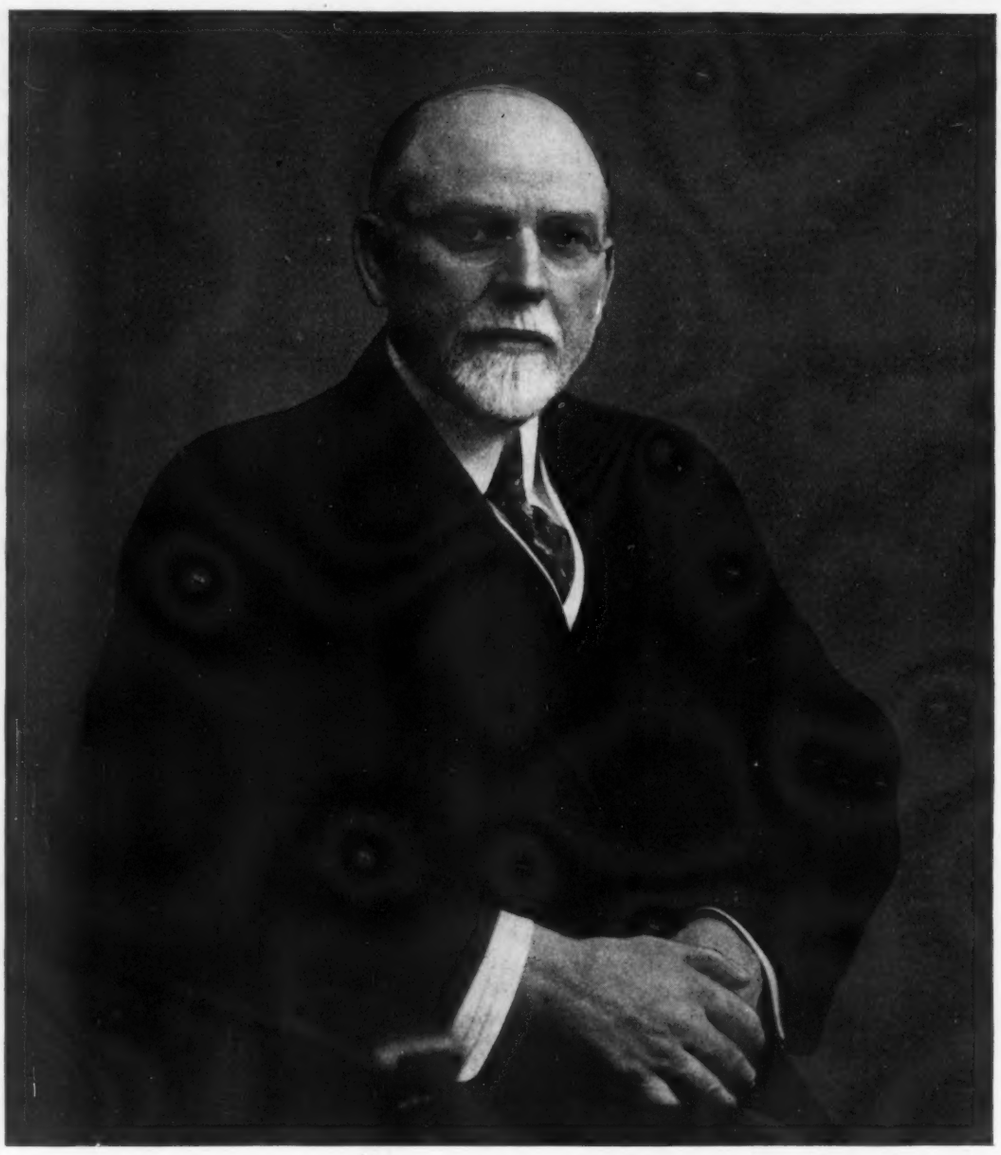
Both systems are distinctly better in general performance than those depending on exciters the operation of which is tied up with that of some or all the main generators, convenient as these have sometimes proved to be. The fundamental thing in an exciting system is that it shall deliver to its generator or generators the required amount of exciting current adjusted so far as is necessary by automatic regulators. If the same source of current is used for other purposes, the steadiness of its functioning is more or less impaired according to the precautions that are taken. On the whole, the more independent the exciting system of the performance of the individual main generators, or of all of them, the more likelihood there is of attaining uniform and effective service.

The objection to an independent exciting plant with its own prime movers, aside from installation expense—for such a purpose a secondary consideration—is the chance of failure applying to any generating system whatever. If provision is made for a motor-driven exciter reserve or for driving the exciters either by motor or prime mover, as might be easy in case of hydro-electric plants, the chance for failure of the exciting circuit is correspondingly reduced. In a big and important generating station the excitation on which continuity of service depends must be absolutely reliable so far as care can make it so. This condition seems to be best met by independently driven units made as nearly trouble-proof as is humanly possible.

Electric Power in Coal Mining

FEW persons realize to what extent electric power is now used in coal-mining operations. It has found its way to this task so gradually and with so little of sensational development that its present importance seems devoid of spectacular interest. Robert Anthony in a brief paper this week discusses the actual power requirements of coal mines as found by a long experience over a considerable range of mines. Taking a broad view of the matter, electric power is used for three distinct purposes in the coal industry. The mine must be ventilated and drained, which implies a steady load so long as the mine is in operation. The coal must be cut, hauled and, in shaft mines, hoisted, which constitutes the group of mining uses proper. Finally, a considerable amount of miscellaneous power is required for the upper works of the mine in getting the material ready for shipment. The distribution of the total power under these three heads varies widely from place to place according to the individual requirements of the mine and in particular depends on whether it is a drift or a shaft mine, hoisting being an important factor in the latter case.

Mr. Anthony's diagrams show very plainly the varying situations found in practice. Cutting the coal is a relatively small item, haulage a much more considerable one. Records from some two hundred drift mines in the Pennsylvania and West Virginia fields show total energy consumption averaging less than 2.5 kw.-hr. per ton. Evidently power in such cases is not a serious factor in the cost of the coal. In shaft mines the hoisting and the pumping and ventilation items are increased so that the totals may easily run to double the output in the average drift mine. In any case the power costs decrease as the output increases by reason of the constant items in the total load. The half output requirements of a mine may well be 50 per cent over the full output requirement reckoned in kilowatt-hours per ton of coal produced.



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Stabilizing Large Generating Systems

The Value of Feeder Reactance in Keeping Alternators in Synchronism Is Urged by Dr. C. P. Steinmetz, Following Analysis of Serious Breakdowns in a Large Generating System—Typical Examples Are Worked Out in Support of His Thesis

VITALLY related to the trend toward large interconnected systems and super-power stations is the problem of stable operation of alternators within a single station or several stations in parallel. Recent experiences in the Commonwealth Edison system showed that in case of short circuit near one of the generating stations the voltage fell to such a low value that the alternators connected to the bus in trouble fell out of synchronism and drifted helplessly for a quarter of an hour or so before the machines could be brought to synchronous speed and the load restored to normal. An investigation of this experience by the engineers of the company, assisted by Dr. C. P. Steinmetz, indicated that there were not sufficient protective reactances in use. The operating conditions which prevailed in the system at the time of the disturbances were reported by R. F. Schuchardt in a paper on "The Use of Reactors in Large Central-Station System," presented at the annual convention of the American Institute of Electrical Engineers on Thursday, and Dr. Steinmetz's analysis of the problem was presented under the title "Stability of High-Power Generating Stations." These two papers are here outlined at considerable length on account of the importance of the problem of stable operation.

The principal supply of the Commonwealth Edison Company is obtained from three large power houses, Fisk Street, Quarry Street and Northwest, as outlined by Mr. Schuchardt. In each of these there are both 25-cycle and 60-cycle turbo-generator units, but the experience here described refers only to the 25-cycle system.

At Fisk Street there are twelve 25-cycle units, rated at 180,000 kw., which are divided into two sections. Quarry Street, with 56,000 kw. in four units, is operated as one section, as is also Northwest station, with three 25-cycle units aggregating 85,000 kw. The generator and the busbar voltage is 9,000 kw. and all of the units are star-wound. Each unit has an oil switch in the neutral, and this switch is closed on one of the operating units in each section, the neutral bus being connected to earth through a 2.5-ohm non-inductive iron-grid resistance. The generators, which range from 12,000 kw. to 35,000 kw. in capacity, are provided for reactors in the phase leads with one exception. The total reactance of the various units, including the external coils, is from 11 to 14 per cent, the higher figure applying to the larger units.

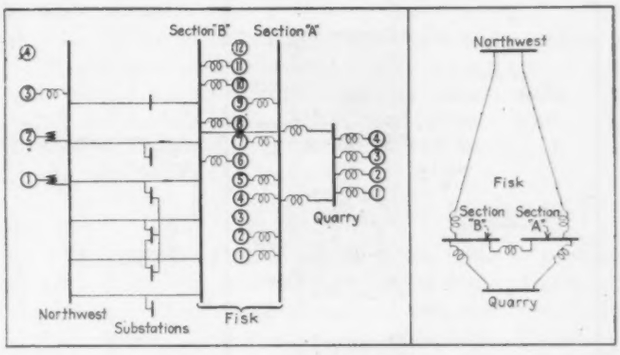
Quarry Street is connected to each of the Fisk Street sections through a short tie line of 750,000 circ.mil, each tie line having a reactor of 1.75 ohms reactance. There was no reactor between the sections of the Fisk Street station. The Northwest station also has a number of transmission lines which connect to one bus section at Fisk Street, but no reactors have been installed in these circuits, this having been postponed until the ultimate capacity at Northwest station had been more nearly fixed.

After generator and bus sectionalizing reactors had been installed it was hoped that the very heavy expenditures necessary for coils and housing for the 150-odd lines in the existing stations could be avoided, but plans for a new station included provision for such feeder reactors.

Cable Failures Make Trouble in the Station

Previous to last year, cable failures were generally at some distance from the station, and the relays promptly disconnected lines when such failures occurred. The disturbance on the system was thus very slight. During the past year, however, there were several failures very close to the busbars, and these had a fairly widespread effect.

On May 19, 1919, at 7:25 a.m., a burn-out occurred in a 12,000-kw. generator on Section A at Fisk Street. The connections are shown in a simplified diagram in Fig. 1. This unit was very promptly cleared by the operator at the switchboard, but immediately an unstable condition resulted and lasted for eighteen minutes. The voltage chart (Fig. 3) showed a constant



FIGS. 1 AND 2—PRESENT CONNECTION SCHEME AND ULTIMATE REACTANCE LAYOUT FOR COMMONWEALTH EDISON PLANTS

swinging of the pressure during this time, the maximum being about 9,100 volts and the minimum, except for the initial drop, about 7,000 volts. The wattmeters and ammeters on the tie lines A and B between Fisk and Quarry and on the lines from Fisk to Northwest swung continuously from one extreme to the other. The frequency varied from 24½ cycles to 26½ cycles. Units No. 2 and No. 7 at Fisk Street tripped their throttles from overspeed. A number of converters in the various substations tripped out. At 7:43 a.m. the disturbance suddenly ceased and the system pressure rose to about 9,400 volts, but was immediately brought to normal.

The experience pointed to the need of more reactance in the tie connections between Fisk and Northwest stations and also to the desirability of installing the Section A-B tie reactors, which had been purchased some time previously but the actual installation of which had been postponed. Arrangements were started to install the A-B coils and, pending the determination of the size of coils for the Fisk-Northwest tie lines, operating instructions were issued to open these lines promptly in the event of trouble producing a condition of instability.

On Sept. 18, 1919, at 3:47 p.m., when the 25-cycle system load was approximately 200,000 kw., a transmission line fed from Section B at Fisk Street broke down within 200 ft. (69 m.) of the station busbars. Because of the closeness to the busbars of this cable failure the voltage dropped to so low a point that all synchronous substation apparatus on Section B and on the Northwest station dropped off and also some of the substation units on the Quarry Street section and on Section A of Fisk Street, owing largely to communication through the direct-current connections. These latter units, however, were quickly restored to service. The load thus being lost on Section B and on Northwest, all of the generating units involved speeded up and the emergency steam valve was tripped. Owing to an incidental happening, the 25,000-kw. unit No. 11, operating on Section B, was disconnected, leaving four of the 12,000-kw. vertical units on the B bus. These units as well as the two which had been in operation at Northwest station were then out of synchronism with the units on those sections remaining normal; that is, Quarry Street and Section A of Fisk Street. Governor control was soon restored on these units, but the out-of-synchronism condition continued for approximately thirteen minutes. After the first seven minutes had elapsed, the reactors on tie line B at Fisk Street showed evidence of excessive current flowing and the tie line meters swung from one end of the scale to the other in irregular beats. Thereupon tie line B switch was opened. Northwest Station and Section B at Fisk Street still remained out of synchronism, however, and the pressure of Section B and Northwest buses remained near zero during the entire thirteen minutes. Fig. 4 shows the pressure charts for the period covering this and the succeeding disturbance.

While the restoration of service following the disturbance just described was in progress and getting on fairly well, another line broke down very close to the busbars. This line had carried an unusually heavy load throughout the day and on excessive load during the period following the first disturbance. The line in question was fed from Section A at Fisk Street, and as the tie line B to Quarry Street, which had been previously opened as above noted, had not yet been closed, the disturbance was not communicated to Section B or the Northwest station lines. There was also no resulting out-of-synchronism condition of any of the Quarry Street or Section A Fisk Street units. It was evident from these disturbances that the installation of feeder reactors in the old stations should not be longer delayed, and it has been decided to use a 0.5-ohm coil for all 9,000-volt, 25-cycle lines. The Section A-B coil at Fisk has been in service for some months and arrangements are being made to provide coils in the tie lines between Fisk and Northwest stations. A suggestion made by Dr. Steinmetz to divide these tie lines into two groups, one group connecting with Section A and the other with Section B at Fisk, has been adopted, so that the bus connections of the three stations will be a figure eight, that is, a double loop, as shown in Fig. 2.

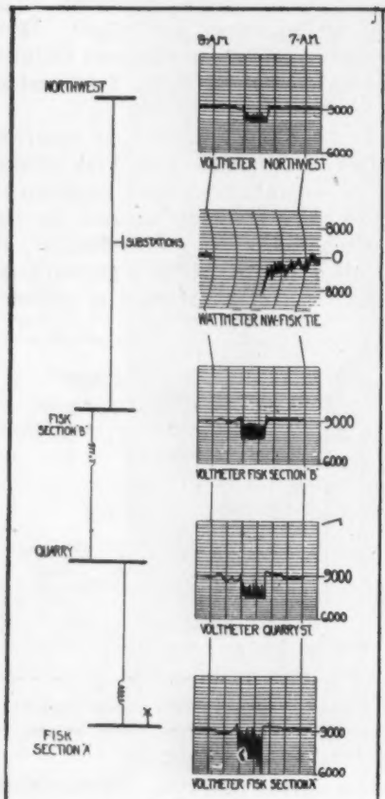


FIG. 3

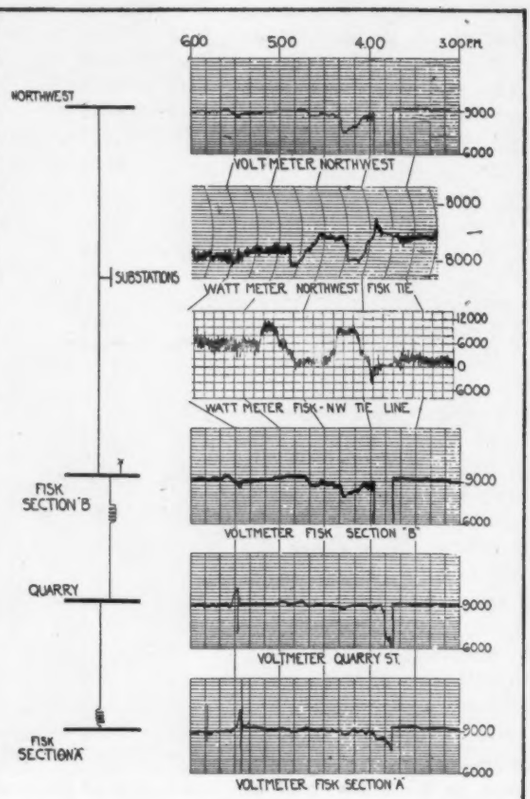


FIG. 4

FIGS. 3 AND 4—CHARTS SHOWING DISTURBANCES OCCURRING IN MAY AND SEPTEMBER

DR. STEINMETZ RECOMMENDS FEEDER REACTORS

In stating his conclusion regarding the use of power-limiting reactors and locating them in the system to the best advantage, Dr. Steinmetz points out the great usefulness of feeder reactors. Even with generator power-limiting reactors and busbar dividing reactors, the effect of a short circuit at or near a busbar section is very severe and probably shuts down this section. As troubles in feeder cables are very much more frequent than at the busbars, the installation of feeder reactors greatly reduces the frequency of serious troubles. While a feeder reactor may be a relatively small percentage, referred to the feeder capacity, it is large relative to the station capacity. It therefore greatly reduces the shock of a short circuit on the system, maintains some voltage on the busbars, and thus, if properly chosen, protects against the dropping out of synchronous apparatus. Also, by permitting a more rapid opening of the circuit breakers, it reduces the duration of the trouble.

A question arises as to what effect this necessary sectionalizing of the system by reactors has on the synchronizing power of the system, and thus on the stability of operation, the more so as in case of trouble a

local and temporary drop of voltage may still further lower the synchronizing power.

Dr. Steinmetz then proposes a specific problem to show that feeder reactors are necessary for the stable operation of alternators within the stations. Considering the effect of a feeder short circuit close to the busbars on a 25-cycle, 9,000-volt generating station of 60,000 kw. steam-turbine-alternator capacity, without and with feeder reactors; assuming that the short circuit is opened after one second; assuming as fair average an equivalent effective reactance of armature reaction of 85 per cent, a true self-inductive internal reactance of the alternators of 6.8 per cent and an external reactance as power-limiting generator reactor of 6 per cent, let the duration of the field transient (full-load conditions be $t_{oo} = 4.51$ seconds and the field attenuation constant $a_o = 0.222$. The transient then is given

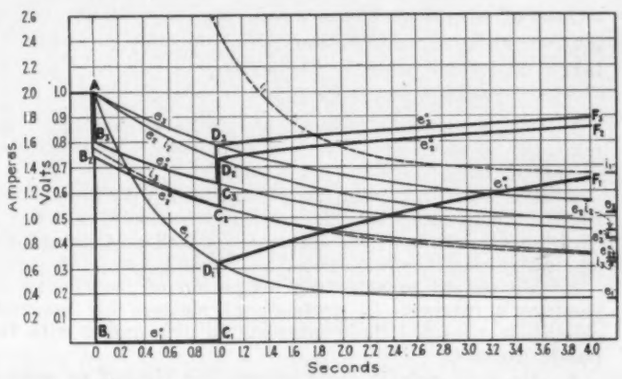


FIG. 5—STEINMETZ CURVES SHOW HOW FEEDER REACTANCE STABILIZES OPERATION OF GENERATING PLANTS

by $e = e_1 + (e_o - e_1)\,\varepsilon^{-a_o t}$, where e_o = voltage of the machine at the moment $t = 0$; for instance, initial voltage in the moment when a short-circuit has been opened. e_1 = machine voltage corresponding to the exciter voltage impressed upon the machine, that is, final voltage of the machine. Three cases are considered:

1. No feeder reactor, thus dead short-circuit on the busbars.

2. A feeder reactor of 0.5 ohm per phase, or 2.9 times the true reactance of the generating station, or 37 per cent.

3. A feeder reactor of 0.7 ohm per phase, or 4.05 times the true reactance of the generating station, or 52 per cent.

1. With 12.8 per cent self-inductive reactance, the momentary or initial short-circuit current, as a fraction of the rated current of the station, is given by $i_o = 7.8$, the final short-circuit current is $i_1 = 1.34$, and the duration of the short-circuit transient is $t_o = 0.582$ second. This gives an attenuation constant $a = 1.72$, and the equation of the short-circuit current transient is $i = 1.34 + 6.46\,\varepsilon^{-1.72t}$. This current is plotted in Fig. 5, marked i_1.

The induced generator voltage, which is given as a fraction of the induced voltage immediately before the short circuit by the transient, is $e = 0.172 + 0.828\,\varepsilon^{-1.72t}$ (plotted as curve e in Fig. 5). The terminal voltage is zero during the short circuit at one second. With the opening of the short circuit the terminal voltage jumps back to the same fraction of the terminal voltage before the short circuit to which the induced voltage has dropped, that is, to the point of curve e_1, 32.2 per cent of the previous terminal voltage. From this point at one second the voltage now gradually recovers on the field transient equation $e^\circ = 1 - 0.678\,\varepsilon^{-0.222t}$. During the short circuit the terminal voltage thus traverses the values of A, B_1, C_1, D_1, F_1, in Fig. 5. As seen, the voltage recovery is very slow, and it is not probable that any synchronous apparatus will remain in step. The short-circuit current after one second in which the circuit breaker has to open is two and one-half times the rated current, or 150,000 kva.

2. With 12.8 per cent self-inductive generator reactance and 37 per cent feeder reactance, the total reactance is 49 per cent, and the cycles of terminal voltage and short-circuit current are again calculated as above and are shown in Fig. 5 by curves i_2, e_2 and e_2°. At the moment of short circuit the terminal voltage makes a sudden drop to curve e_2° to 0.744 of the previous value, then follows the curve e_2° for one second, then on opening the short circuit suddenly jumps from 0.543 on e_2° curve to 0.732 on e_2, and then gradually recovers on the field transient given by the equation $e_o = 1 - 0.268\,\varepsilon^{-0.222t}$. The terminal voltage thus traverses the broken curve $AB_2C_2D_2F_2$.

While the voltage recovery after the short circuit is slow, the terminal voltage even during the short circuit remains above half value. The current after one second when opening the short circuit is only 1.46 times full-load current.

3. In the same manner the curves are calculated for 52 per cent feeder reactance and the values as shown in Fig. 5 are i_3, e_3, e_3°, giving for the terminal voltage the curve $AB_3C_3D_3F_3$. The short-circuit current, when the circuit breaker opens after one second, is only 9 per cent above full-load current.

How Synchronism May Be Lost

The question then arises of the bearing of these voltage curves on synchronous operation. During the period of dead short circuit or zero terminal voltage, B_1C_1, there is no synchronizing power. There is no load on the generators beyond the i^2r, and the load losses, which are moderate even at this initial high momentary short-circuit current, rapidly decrease with the decreasing short-circuit current. Thus the alternators speed up until the governor shuts off steam or the emergency governor trips. The former necessarily must take an appreciable time to avoid trouble from steam governor hunting. Usually, the speeding up will occur until the emergency trips and cuts off steam about 10 per cent above normal speed. Then slowing down occurs until the machines are again put on their governors. The speeding up, however, occurs at different rates, owing to the differences in the momentum of different machines; the speed of tripping cannot be exactly the same, as absolute reliability rather than exactness of speed is the main requirement of the emergency cut-off, and, furthermore, some speeding up will continue after the closing of the governor, owing to the steam contained between the cut-off and the turbine, and in the turbine.

Thus, if during this period the machines do not have sufficient power to keep each other rigidly in step, at the time when the short-circuit current is cleared and the voltage returns, the machines probably have drifted so far apart that they cannot pull each other into step again, but continue slipping out of synchronism, short-circuiting each other and keeping zero terminal voltage

indefinitely. An equation which gives the limits of synchronizing power—that is, the maximum speed difference from which the machines can pull each other into step promptly—is then derived by Dr. Steinmetz. It is shown that even in the fraction of a second—that is, in a time much shorter than the circuit breaker can open a short circuit—machines of different types have drifted apart by greater speed differences than those at which the machines can pull each other into step again at their reduced synchronizing power.

However, even with identical machines, especially if the speeding continues to the tripping of the emergency steam valve, inevitable inequalities in the tripping speed and in the time of restoring the machines on steam governor control probably cause greater speed differences than is permissible by the synchronizing power. Furthermore, even if the short circuit is opened in a second or less, the induced voltage has dropped so considerably—e_1 in Fig. 5—and the recovery curve—e_1° in Fig. 5—is so slow, that the machines cannot immediately take load, and speeding up continues for some time.

Thus it may be expected that with a dead short circuit at or near the busbars of a high-power steam-turbine station, the generators drop out of synchronism and are not able to pull back promptly, but begin to drift indefinitely, slipping past each other at zero voltage.

For a machine to remain in synchronism with other machines, with full-load steam supply and the load thrown off by a short circuit, etc., the machine must be able to transfer full load to other machines, within its limits of synchronizing power, that is, with a phase displacement not exceeding 90 deg.

Dr. Steinmetz showed that the voltage limit of synchronizing power in most large machines is a little below half voltage, and the conclusion follows that:

As long as the machines do not drop below half voltage, no danger exists of the machines breaking out of synchronism by the sudden loss of load under short circuit or other accidents, and,

If a feeder reactor limits the voltage drop of the station, due to a feeder short circuit, to 50 per cent or less, the machines in the station remain in synchronism, even when speeding up due to the release of load, when tripping their emergency steam cut-offs, etc., and the voltage thus recovers immediately on the opening of the short circuit.

As seen from Fig. 5, this is the case even with the smaller feeder reactor, and under the given conditions, the smaller feeder reactor thus should offer complete protection against loss of synchronism of the station as result of a feeder short circuit.

Similar relations then exist between generating station and synchronous machine loads, such as converters and synchronous motors.

The synchronous converter probably represents by far the most frequent synchronous machine load. Its internal characteristics are somewhat similar to those of the steam-turbine alternator—that is, high effective reactance of armature reaction and low true self-inductive reactance—and it therefore is probable that about the same numerical relations pertain.

Such values of feeder reactors, which are sufficient to guard the generating stations against loss of synchronism by maintaining the station under feeder short circuits, above the voltage limit of synchronizing power, may in general be expected also to guard the synchronous converters in the substations against being thrown out of step—that is, shut down by the shock on the system due to feeder short circuit.

Mechanical Engineers Propose New Code of Ethics

A NEW code of ethics, which may serve as a basis for a code of principles for all engineers, has been proposed by the American Society of Mechanical Engineers and presented before its recent semi-annual meeting and also before the Federation of American Engineering Societies.

The essential feature of the code is its brevity. It contains but fourteen short paragraphs and is intended to be a brief positive statement of the professional relations of engineers to the public, to their clients or employers and to one another. Action will probably be taken on its adoption in December.

The proposed code is as follows:

1. The mechanical engineer should be guided in all his relations by the highest principles of honor, of fidelity to his client and of loyalty to his country.
2. His first duty is to serve the public with his specialized skill. In promoting the welfare of society as a whole he advances his own best interests as well as those of the whole engineering profession.
3. He should consider the protection of his client's or employer's interests in professional matters his essential obligation, provided these interests do not conflict with the public welfare.
4. He shall refrain from associating himself or continuing to be associated with any enterprise of questionable or illegitimate character.
5. He can honorably accept compensation, financial or otherwise, from only one interested party unless all parties have agreed to his recompense from other interested parties.
6. He must inform his clients of any business connections, interests or circumstances such as might influence his judgment or the quality of his services to his clients.
7. He must not receive, directly or indirectly, any royalty, gratuity or commission on any patented article or process used in the work upon which he is retained without the consent of his clients or employers.
8. He should satisfy himself before taking over the work of another consulting engineer that good and sufficient reasons exist for making the change.
9. He must base all reports and expert testimony on facts or upon theories founded only on sound engineering principles and experience.
10. He must not regard as his own any information which is not common knowledge or public property, but which he obtained confidentially from a client or while engaged as an employee. He is, however, justified in using such data or information in his own private practice as forming part of his professional experience.
11. He should do everything in his power to prevent sensational, exaggerated or unwarranted statements about engineering work being made through the public press. First descriptions of new inventions, processes, etc., for publication should be furnished only to the engineering societies or to the technical press.
12. He should not advertise in an undignified, sensational or misleading manner, or offer commissions for professional work, or otherwise improperly solicit it.
13. He should not compete knowingly with a fellow-engineer for employment on the basis of professional charges or attempt to supplant a fellow-engineer after definite steps have been taken toward the other's employment.
14. He should assist all his fellow-engineers by exchange of general information and valuable experience or by instruction through the engineering societies, the schools of applied science and the technical press.

Interconnection in Southern Vermont

Tying Hydro-Electric Properties Together for Co-operative Service Saves Fuel and Water—Centralization of Dispatching Functions Helpful—Graphic Analyses of Intercompany Operations

CHITTENDEN RESERVOIR, WHICH IS MAINSTAY OF VERMONT HYDRO-ELECTRIC CORPORATION

THE progressive interconnection of hydro-electric systems in southern Vermont is establishing a new era in central-station operations in a section of New England hitherto handicapped by isolated utility administration. Taken with the consolidation of various properties in the Rutland district into a single administrative system, the interchange of energy now attained between both industrial and public utility plants is making it possible to handle rapidly increasing loads more effectively, conserve water, avoid the importation of coal or oil on any appreciable scale, utilize labor to better advantage and, last but not least, to keep down the investment burden necessary to supply service in the southern Green Mountain area. The Green Mountain range traverses the state from north to south and affords an abundant supply of water for power, agricultural and other purposes. For many years hydro-electric energy has been utilized extensively throughout the state, but it is only of late that the advantages of interconnection and plant co-ordination have been realized and a comprehensive development exploited.

Southern Vermont Interconnection Comprises Five Systems

Five important systems of hydro-electric supply are now interconnected in the Rutland district, the Vermont Hydro-Electric Corporation, the Hortonia Power Company, the Vermont Marble Company, the Rutland Railway, Light & Power Company and the Fall Mountain Electric Company (supplied from the Vernon station of the New England Power Company interests. These interconnections are still in process with a larger plane of usefulness in sight when new plant developments are completed, but much has already been accomplished, as this study of the Rutland system indicates.

The total generating capacity available for southern Vermont through the interconnection of about a score of plants on these systems is about 27,500 kw. in present installed units, including 3,500 kw. available from the Fall Mountain tie line north of Bellows Falls. The co-operation of these various plants is advantageously shown in the accompanying diagram of energy outputs through October, 1919, and in the diagram of energy interchanges for the calendar year 1918. Conservation of water is perhaps the most striking result indicated, and this has been effected through load dispatching of a very high order of excellence.

In considering the operating co-ordination accomplished on these systems a brief survey of their extent is desirable, with a short account of the improvements recently effected and in progress through consolidation and upbuilding. The operating headquarters of the Vermont Hydro-Electric Corporation and the Hortonia Power Company are both in Rutland, which may fairly be regarded as the load center of the interconnected systems. To the north, northwest and northeast are the generating plants and transmission lines of the Hortonia company. Along a general north and south line running to the west of Rutland is the system of the Vermont Marble Company, with headquarters at Proctor. Northeast of Rutland and extending to the southeast are the lines and plants affiliated with the Vermont corporation, extending into Claremont, N. H., and thence down the Connecticut Valley by tie line to Bellows Falls and the Vernon station, the last being the largest hydro-electric plant on the Chase-Harriman system (New England Power Company group).

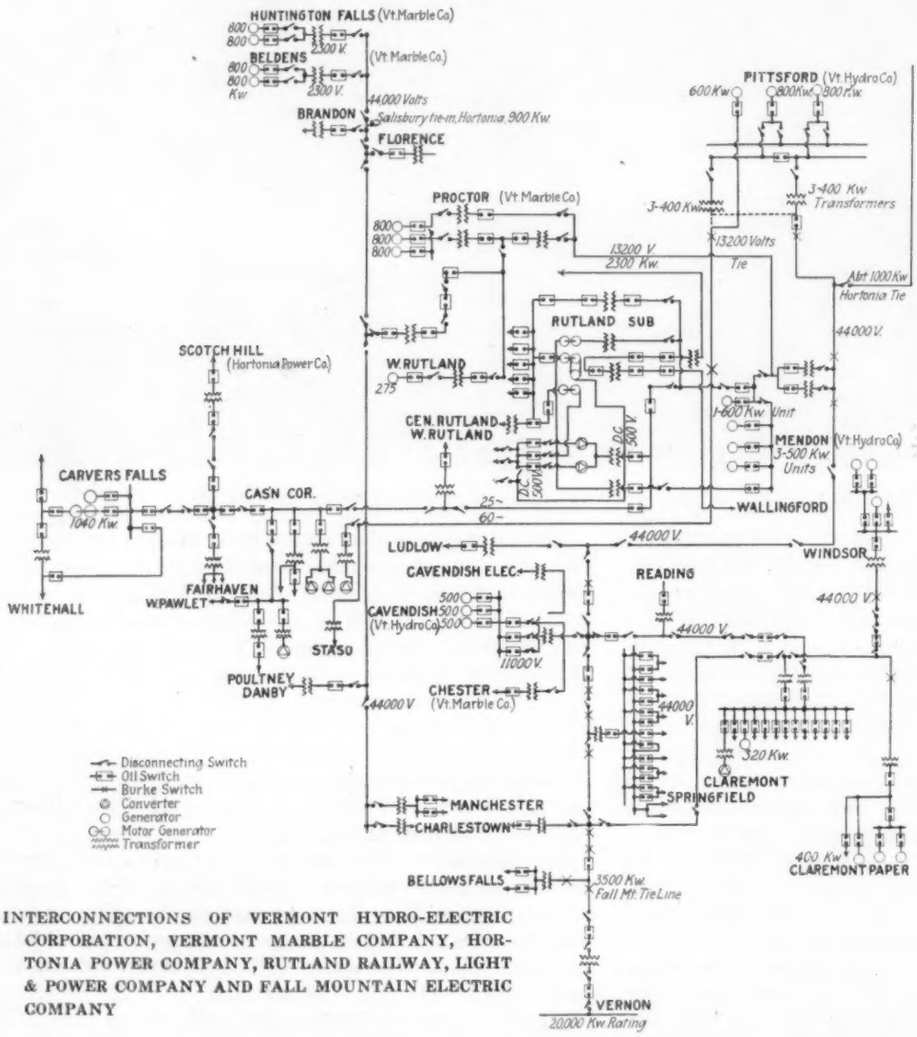
The Vermont Hydro-Electric Corporation acquired in 1919 the plants and lines of the Colonial Power & Light Company, Western Vermont Power & Light Company, Claremont Power Company (of New Hampshire), water

rights of the Clarendon Power Company (of Vermont), the Mendon generating station of the Rutland Railway, Light & Power Company, and the control of the hydro-electric production of the Pittsford Power Company, in order to correlate the plants, obtain larger amounts of energy, sell greater quantities of electricity in southern Vermont and effect economies in management, and further, to raise more readily capital for the development of additional generating facilities.

The Hortonia Power Company, organized in 1915, includes the following consolidated properties in its own system: Neshobe Electric Company, Lake Dunmore Power & Traction Company, Gaysville Electric Light & Power Company and White River Electric Company. This system is being co-ordinated into an operating organization with centralized direction, but at this writing additional transmission-line construction remains to be completed in order that the plant groups may be interconnected between the Bethel and Wells River districts. The major service of the system is furnished in west-central Vermont, and the company's lines extend across the southern end of Lake Champlain into New York State.

The Vermont Marble Company's system is built upon the industrial development of the marble region west and north of Rutland, with a group of hydro-electric stations interconnected with the Vermont Hydro-Electric and Hortonia systems for advantageous use of water and interchange of energy. The Rutland Railway, Light & Power Company handles the central-station and electric railway service of the immediate Rutland district and is operated by the Vermont Hydro-Electric Corporation management. The Fall Mountain system includes no active generating plants, but is a distributer of the New England Power Company organization.

The engineering characteristics of the plants on the foregoing systems are extremely varied. The installations now in service include low, medium and high-head developments, with and without substantial storage facilities. Plant capacities are moderate for the most part, and both 25-cycle and 60-cycle loads are being handled. The most important interconnections are by 44,000-volt, 60-cycle, three-phase transmission. The eighteen principal hydro-electric plants operated on these systems illustrate a range in heads of from 16 ft. to 675 ft. (5.9 m. to 206 m.), with a range in available capacity of from 250 kw. to 3,500 kw. These systems represent a gradual development of local resources and extension of operations to include adjacent markets and interstation co-operation. Some of the plants represent obsolete designs; others afford examples of modern engineering and operating co-ordination. Certain tendencies toward standardization can be seen in plants developed by a single interest and under centralized engineering supervision, but in many respects the properties involved in southern Vermont interconnection are of such a heterogeneous character that it is difficult to trace any general problem solution in the evolution of the plants themselves. At the same time, some engineering and operating details suggest the line of advance being followed in the better utilization of the hydro-electric resources of the particular territory served.

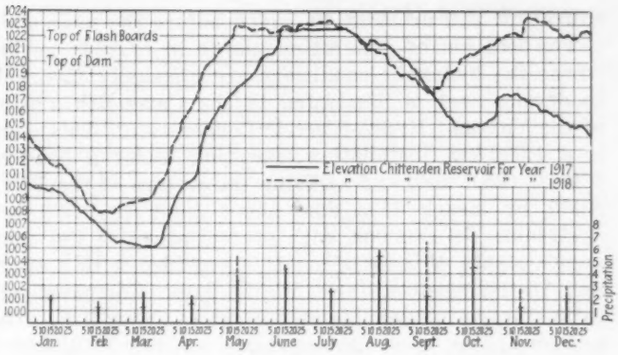


INTERCONNECTIONS OF VERMONT HYDRO-ELECTRIC CORPORATION, VERMONT MARBLE COMPANY, HORTONIA POWER COMPANY, RUTLAND RAILWAY, LIGHT & POWER COMPANY AND FALL MOUNTAIN ELECTRIC COMPANY

ENGINEERING METHODS INVOLVED IN TERRITORIAL HYDRO-ELECTRIC DEVELOPMENT

Some of the more important engineering methods concerned in the development and co-ordination of plants in this district are as follows:

1. Selection of direct-connected units and discard of belt-connected installations in new work.
2. Use of more efficient waterwheels.
3. Use of similar plant designs under favorable conditions.
4. Development of plants to reutilize water on given watershed.


Top of Flash Boards
Top of Dam
Elevation Chittenden Reservoir For Year 1917
1918
Precipitation
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.

VARIATIONS IN ELEVATION OF CHITTENDEN RESERVOIR WITH CORRESPONDING PRECIPITATION FOR 1917 AND 1918

5. Increasing capacity of exciting plants.
6. Concentration of 25-cycle load for localized supply.
7. Development of plants in gorge sites.
8. Use of frequency changers to increase flexibility of operation.
9. Extension of transmission lines.
10. Diversion of existing streams to increase water supply.

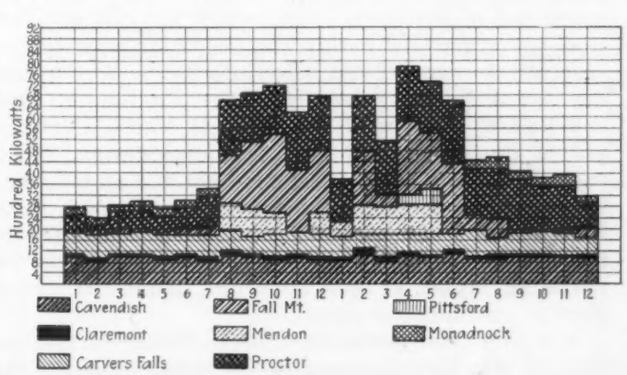
In general, the tendency is to do away with belted generating units in these plants except where the installations are relative'y old and of small capacity. In some cases a combination unit consisting of 25-cycle and 60-cycle generators belted or direct-connected to a single waterwheel is utilized. None of the modern stations, of course, uses other than direct-connected equipment, but the necessity for supplying railway rotary converters at 25 cycles as well as 60-cycle loads has required the employment of double-frequency outfits in some installations. The replacement of old wheels by more efficient designs is also being gradually accomplished.

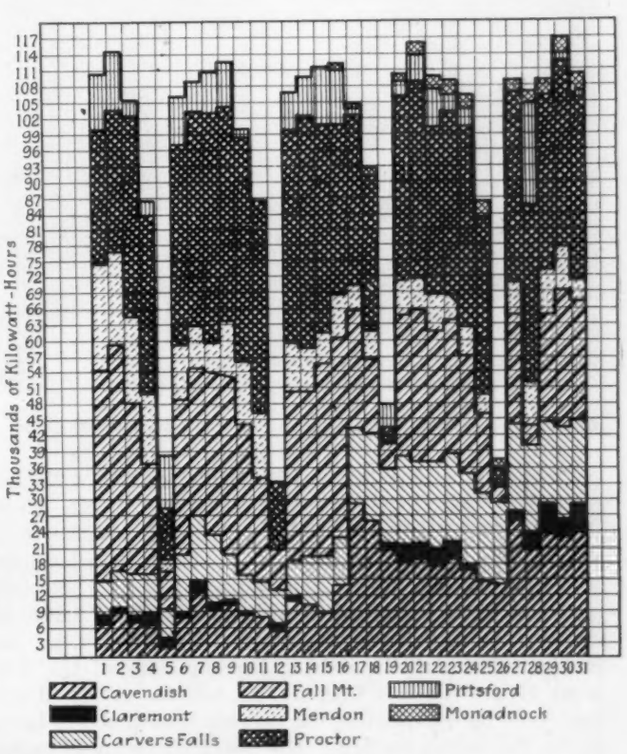
REHABILITATION OF CARVERS FALLS TO INCREASE OUTPUT 8,500,000 KW.-HR.

Elimination of belt driving, the substitution of more efficient wheels and increase of capacity by raising the head from 120 ft. to 185 ft. (36.5 m. to 56.3 m.) illustrate a program of betterment planned for early accomplishment at the Carvers Fa'ls station of the Hydro-Electric Corporation. This plant is situated on the Poultney River, and the present installation consists of two 500-kva., 25-cycle generators direct-connected to waterwheels and a 300-kva., 60-cycle generator belted to one of the 500-kva. generators. The head will be raised by building a new dam 1,200 ft. (365 m.) above the present dam. Water will be taken to the plant through a wood-stave pipe line 78 in. (200 cm.) in diameter and terminating after a run of 2,000 ft. (610 m.) in steel penstocks about 400 ft. (120 m.) long. In the present station building will be housed two 1,250-kva. generators direct-connected to two waterwheels, with space for a future third unit. This redevelopment will increase the output of this station by about 5,900,000 kw.-hr. primary energy and 2,650,000 kw.-hr. secondary energy per year, making the total output 13,200,000 kw.-hr. at Carvers Falls. The estimated cost of the redevelopment is $200 per kilowatt, or $400,000 total. When redeveloped, the output will be 7,900,000 kw.-hr. primary and 5,300,000 kw.-hr. secondary. The 1918 output of this plant was 2,000,000 kw.-hr. primary and 2,650,000 kw.-hr. secondary energy.

The storage in this watershed, which covers about 186 sq. miles (475 sq.km.), can be materially increased by the utilization of several small lakes and ponds. The present available storage consists of 574,600,000 cu.ft. (16,250,000 cu.m.) in Lake Bomoseen and Glen Lake, and the additional storage under consideration above brings the total possible storage to 749,100,000 cu.ft. (21,210,000 cu.m.), or 4,000,000 cu.ft. per square mile (290,000 cu.m. per sq.km.). In the remodeled plant the efficiencies of the waterwheels and turbines are computed at 73 per cent and 91.4 per cent respectively.

The increased use of water upon an existing watershed is also being provided for at the so-called No. 3 development of the Vermont Hydro-Electric Corporation, about 2 miles (3 km.) north of Rutland. At this point, on East Creek, there is now under construction a 2,000-kw. (initial capacity) station of two units to operate under a head of 175 ft. (53.4 m.). The estimated cost of this installation is about $400,000. This new station will utilize the water which has passed through the Pittsford and Mendon stations, and will also take water from the south branch of East Creek,





TYPICAL LOAD VARIATIONS AND CORRESPONDING OUTPUT OF VERMONT HYDRO-ELECTRIC CORPORATION FOR OCTOBER, 1919

which does not serve the two upper stations. The dam site for this development is about 2,000 ft. (610 m.) below the Mendon station, and water will be taken to the new station by a 78-in. (200-cm.) wood-stave pipe line about 8,000 ft. (2,440 m.) long. The output of No. 3 station will be about 5,000,000 kw.-hr. annually, with two units in service. This station will have the great advantage of the stream regulation furnished by the Chittenden and Pittsford reservoirs. The capacity of the former is about 1,000,000,000 cu.ft. (28,400,000

CLARENDON GORGE, WHICH WILL IMPOUND 50,000,000 CU.FT.

cu. m.) and of the latter 150,000,000 cu.ft. (4,250,000 cu. m.). From the Chittenden Reservoir to No. 3 station the river falls about 900 ft. (275 m.). With proper handling it is expected that No. 3 station can be operated at 2,000 kw. output ten hours a day and 300 days per year. The Pittsford plant produces about 5,000,000 kw.-hr. and the Mendon station 4,000,000 kw.-hr. annually. The load-dispatching headquarters of the Vermont Hydro-Electric Corporation will be at No. 3 station upon its completion, the present headquarters being at the Cavendish station. The No. 3 station will supply additional energy greatly desired in the southern Vermont and western New Hampshire territory, and a third unit will probably be added before the year ends.

The location of generating plants in or near gorges where the hydraulic conditions are unusually favorable to development is illustrated in the Cavendish station of the Vermont Hydro-Electric Corporation. This plant is a 1,500-kw. installation operating under a head of 120 ft. (35.6 m.), and utilizing the waters of the Black River by means of a dam about 1,000 ft. (305 m.) upstream. In common with several other of the company's plants, this installation is provided with a surge tank in the penstock line from the dam. Comparatively little storage is available at present at Cavendish. The company now owns water rights on the Mill River, southwest of Rutland, which include a gorge permitting a development of nearly the entire watershed of the Mill River.

The total watershed above the proposed dam covers about 66 square miles (170 sq.km.). It is planned to build a dam about 70 ft. (21 m.) high in the Clarendon Gorge, which is over 100 ft. (30 m.) deep and 130 ft. (40 m.) wide, impounding about 50,000,000 cu.ft. (1,420,000 cu.m.) of water. The water will be conveyed to the generating station by a 78-in. (200-cm.) wood-stave pipe 9,500 ft. (2,900 m.) long, with a final steel penstock section 1,700 ft. (519 m.) long. The available static head will be 305 ft. (93 m.). A 2,000-kw. generating station is contemplated, and the estimated cost of the development is $450,000.

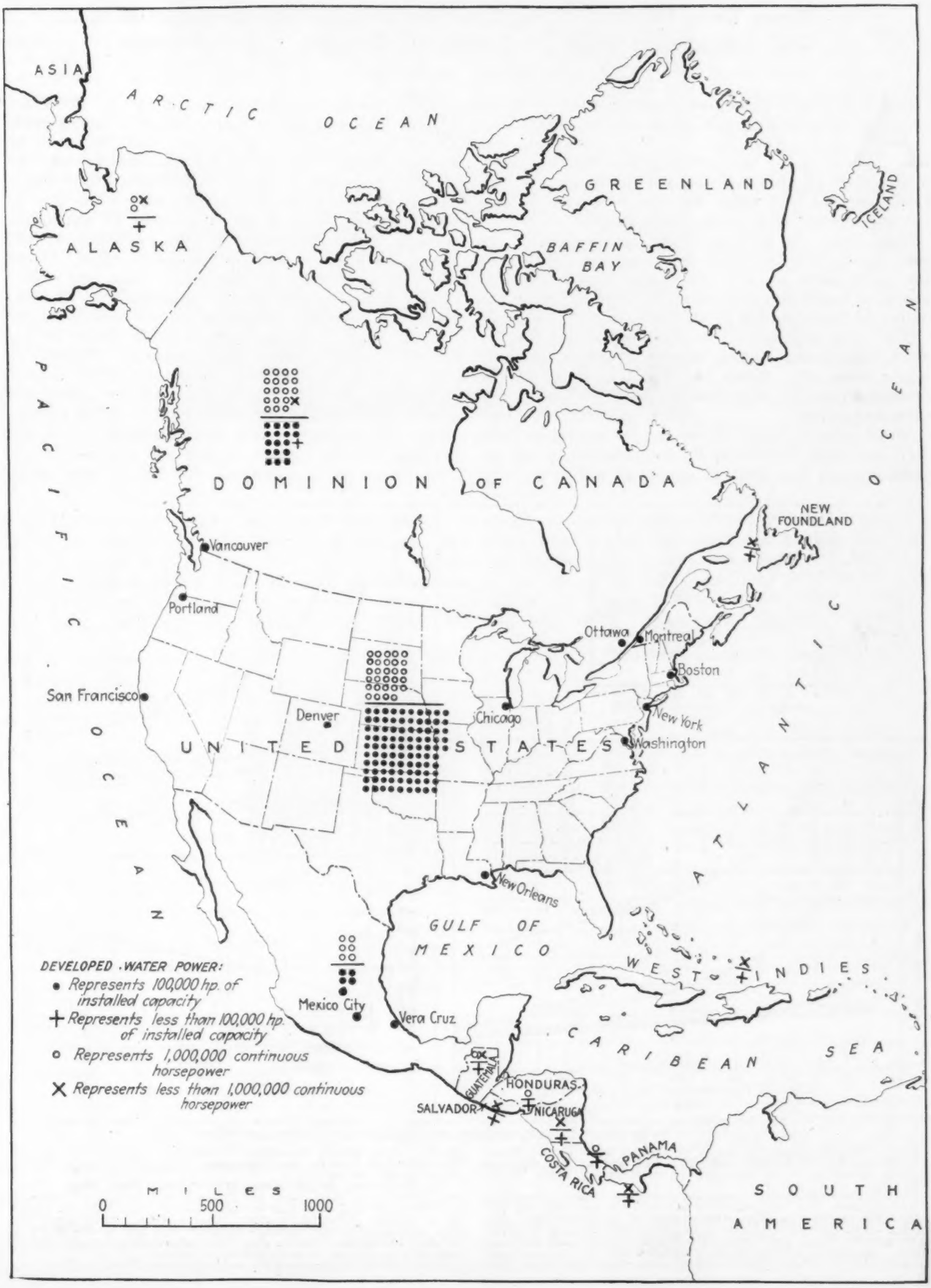
When the No. 3 station, Carvers Falls redevelopment, and the new plant on Mill River are completed, the estimated annual output of the hydro-electric stations of the Vermont corporation's immediately controlled system will be about 41,000,000 kw.-hr., about two-thirds of which will be primary power. The Cavendish station produces about 5,000,000 kw.-hr. a year, and the Clarendon station will deliver about 8,000,000 kw.-hr. The amount of steam power interconnected with this system in small mill or public utility plants is so small as to be practically negligible, although it is of some slight operating advantage.

EIGHT STATIONS TO USE WATER IN SUCCESSION USING SAME STORAGE

The hydro-electric plants of the Vermont Marble Company are located on Otter Creek, which receives water from East Creek and Mill River, as well as from smaller tributaries. These stations, four in number, and the Mendon and Pittsford stations are established in " hydraulic series," together with the Middlebury station of the Hortonia Power Company, so that when the Vermont Hydro-Electric Corporation's No. 3 station is completed there will be eight plants using water in succession in the Otter Creek valley, co-ordinated into close operating relationship and benefiting more or less from the storage and regulation afforded by the Chittenden and Pittsford reservoirs. The Huntington Falls and Beldens stations of the Vermont Marble Company are in this group and are of similar design. Each operates under a 40-ft. (12.2 m.) head and contains two 750-kw. units directly driven by waterwheels. Three 750-kw. units comprise the generating equipment of the marble company's Proctor station, which is the operating center of this important industrial hydro-electric transmission system.

In a later issue of the ELECTRICAL WORLD further details of this New England development, including the 675 ft. (206 m.) plant of the Hortonia Power Company will be given.

Water Powers of North America



Power Requirements for Coal Mining

Energy Consumption and Minimum Demand of Bituminous Coal Mines Shown Under Different Mining Conditions and with Varying Output of Coal — Suggestions Made for Successfully Changing Over Old Mines

By ROBERT ANTHONY

ANALYSIS shows that power is used for three general purposes in the operation of a coal mine: First, it is required to ventilate and drain the mine properly in order to make it a safe place in which to work. This requires a practically constant load which does not vary with the output and depends upon the gas and water conditions.

Then comes the hoisting, hauling and mining of the coal, all of which fall under the second general purpose for which power is used. The power required for this group of operations increases and decreases with the output of the mine and in about the same ratio.

The third classification includes power for the top work, comprising tipples, screens, washers, machine repair shops, etc. Power for this work increases and decreases with the output of the mine, but not in the same proportion.

These general classifications can be applied to both drift and shaft mines, but the interrelation is not the same in these two types of mines, as will be seen by referring to the curves in Figs. 1, 2 and 3. There are some energy-consumption figures, however, which apply for both drift and shaft mines. For instance, the average energy consumption for undercutting coal and moving the cutter is about 85 watt-hours per square foot (8 watt-hours per sq. m.). In some mines only 75 watt-hours is consumed per square foot (7 watt-hours per sq.m.), though in extreme cases and where the coal is very hard 125 watt-hours may be required. If the coal-cutting machine is kept in one place, the undercutting alone requires from 55 watt-hours to 85 watt-hours per square foot (5 watt-hours to 8 watt-hours per sq.m.). None of these figures includes losses in any converting or transforming equipment. Eighty-five watt-hours per square foot (8 watt-hours per sq.m.) is equivalent to about 0.5 kw.-hr. per ton for cutting and moving in a seam 4.5 ft. to 5 ft. (1.35 m. to 1.5 m.) thick. The haulage of coal consumes about 1.2 kw.-hr. per ton, and the haulage of men and materials about one-quarter of that amount on the average when

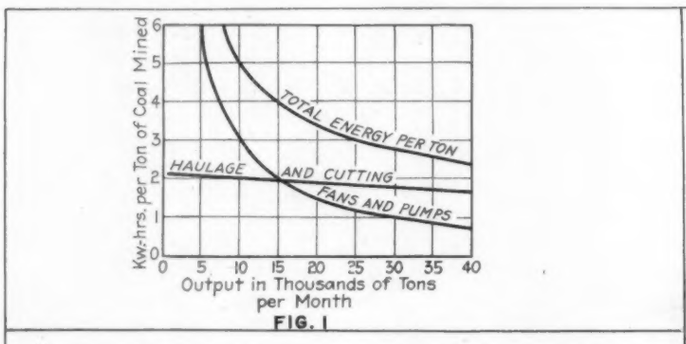
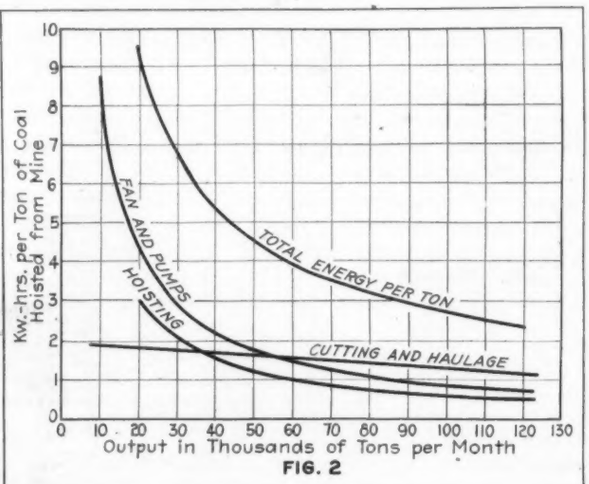
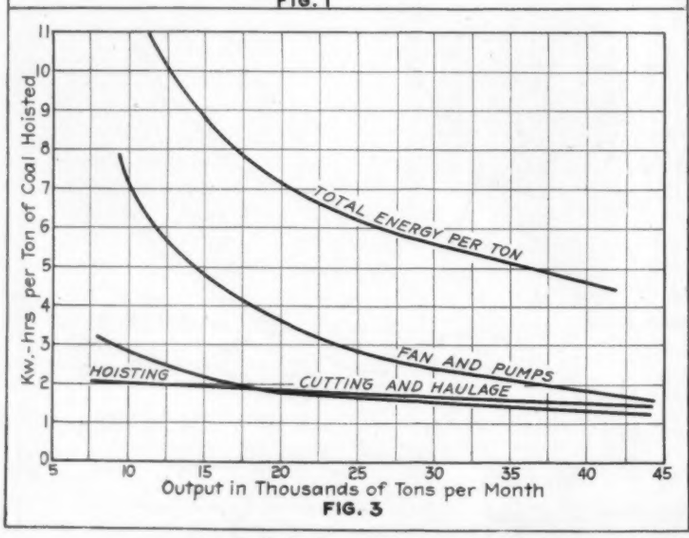


FIG. 1


Kw.-hrs. per Ton of Coal Hoisted from Mine
FAN AND PUMPS
HOISTING
TOTAL ENERGY PER TON
CUTTING AND HAULAGE
Output in Thousands of Tons per Month
FIG. 2


Kw.-hrs per Ton of Coal Hoisted
TOTAL ENERGY PER TON
FAN AND PUMPS
HOISTING
CUTTING AND HAULAGE
Output in Thousands of Tons per Month
FIG. 3

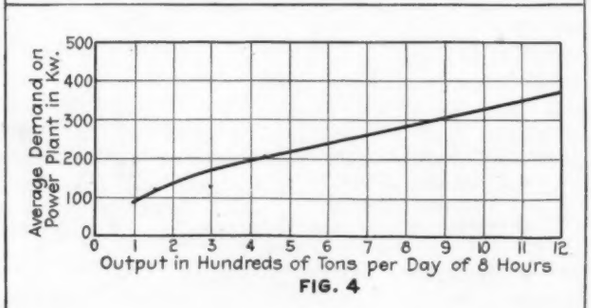


FIG. 4

FIGS. 1, 2, 3, 4 — POWER REQUIREMENTS SHOWN GRAPHICALLY FOR SHAFT AND DRIFT MINES

Fig. 1—*Energy Requirements of a Typical Drift Mine.* These are curves of a three-drift mine in a 5-ft. seam. The average monthly output is 25,000 tons and the maximum is about 35,000 tons.

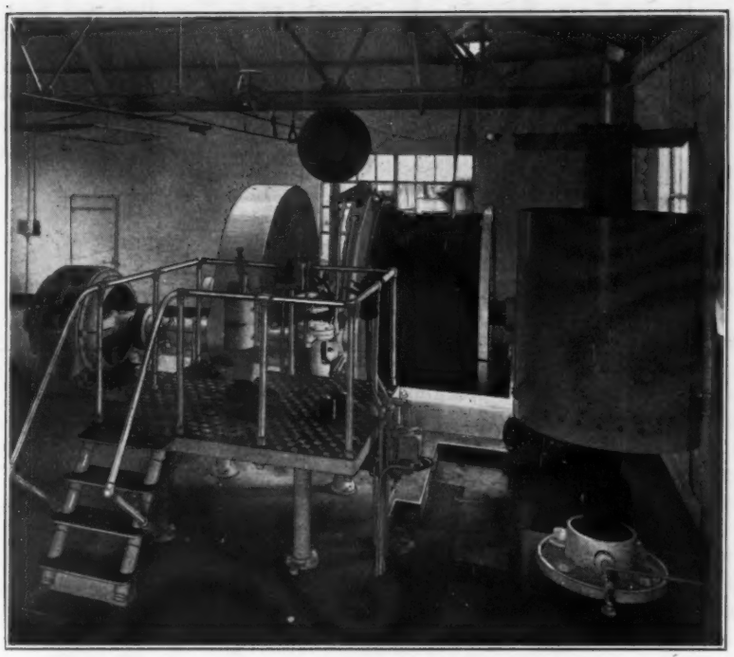
Fig. 2—*Tests of Energy Consumed in a Shaft Mine.* The shaft is 240 ft. deep and the mine is rated at 1,000 tons of coal per hour. The electrical equipment consisted of the following: One 800-hp. direct-current coal hoist operated from a 500-kw. flywheel motor-generator set, one 250-hp. alternating-current men and material hoist, three 200-kw. motor-generator sets for underground haulage, thirty 50-hp., three-phase coal-cutting machines, one 250-hp., three-phase, two-speed ventilating motor, 150 hp. in three-phase motors for the tipple and shops and 50 hp. in three-phase motors on pumps.

Fig. 3—*Energy Requirements of a Typical Shaft Mine.* These are curves of a shaft mine 450 ft. deep and with a capacity of 2,000 tons of coal in a day of eight hours. The hoist is driven by a 450-hp. induction motor; three 150-kw. motor-generator sets operate the mine haulage system; the fan is driven by a 100-hp., three-phase motor, and other alternating-current motors aggregating 200 hp. to drive pumps are used.

Fig. 4—*Average Demand for a Single-Drift Mine.*

measured on the alternating-current side of the motor-generator set. These energy consumptions total about 2 kw.-hr. per ton for cutting and hauling based on an average haul of ⅛ mile (1.4 km.) against a grade not exceeding one-half of 1 per cent.

Cutting and hauling constitute the principal power requirements of drift mines. The records from some 200 drift mines in Pennsylvania and West Virginia show an energy consumption ranging from 1.5 kw.-hr. per ton under the most favorable conditions to about 7 kw.-hr. per ton in extremely gaseous and wet mines. Under average conditions the entire energy consumption was 2.35 kw.-hr. per ton and the average output of drift mines approximated 400 tons per drift per day.



GEARED ALTERNATING-CURRENT HOIST

The motor on the hoist is 400-hp., 2,200-volt, three-phase, 60-cycle. The WR^2 of the hoist drums and gears is 450,000. The hoisting weights are: Coal, 5,000 lb.; cage, 11,500 lb.; car, 3,500 lb. The maximum rope speed is 1,830 ft. per minute and the diameter of the rope is 1.375 in.

The energy consumption of shaft mines is generally greater than that of drift mines by an amount which depends largely upon the depth of the mine, the amount of water which has to be pumped out, and ventilation requirements. Fig. 3 is a typical curve of the energy requirements of a shaft mine with a capacity of 2,000 tons per day of eight hours, while Fig. 2 gives the test results from a mine having a capacity of 1,000 tons per hour.

Old shaft mines are usually the more difficult type to change over to electric service on account of the trouble and expense of changing over the hoisting equipment. It has been found preferable to install a new hoist designed especially for motor drive when possible, but a great deal of money can often be saved by gearing a motor to the old steam equipment. When this is done it must be remembered that the electric motor will not speed up as the old engine would under pressure, and a motor should therefore be selected on a working margin of not less than 25 per cent. The electric hoist has proved superior to the steam hoist from operating and economical standpoints, but some operating men do not admit this because they have not had the proper size and type of electrical equipment.

From an installation viewpoint the induction motor is a cheap motor to place on a hoist, and in sizes up to about 400 hp. it is usually more economical in operating cost per ton of coal hoisted from mines. These induction motors are geared to the hoist in nearly every instance, and a typical load curve of a mine so equipped is given in Fig. 5. When larger motors than 400 hp. are required the tendency is to use a direct-current motor either geared or coupled, and supplied with energy from a motor-generator set. The peak load with a synchronous motor-generator set will be approximately the same as with an induction-motor hoist, but the synchronous motor can keep up the power factor. A flywheel type of an induction-motor-generator set is best for very large direct-current hoists to minimize peaks.

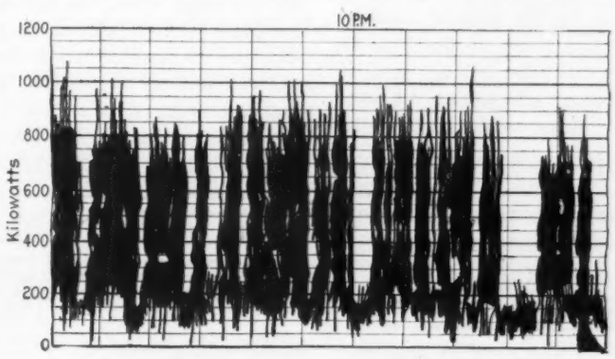


FIG. 5—TYPICAL SECTION OF A LOAD CURVE FROM A SHAFT MINE

This curve was taken during the war, when the mine was operating twenty-four hours per day. The shaft is 300 ft. deep and the rated output is 2,500 tons in eight hours. It will be noted that the haulage, pumping, ventilation, etc., require up to about 300 kw. The peaks above this point are caused by a 300-hp. induction motor driving the hoist.

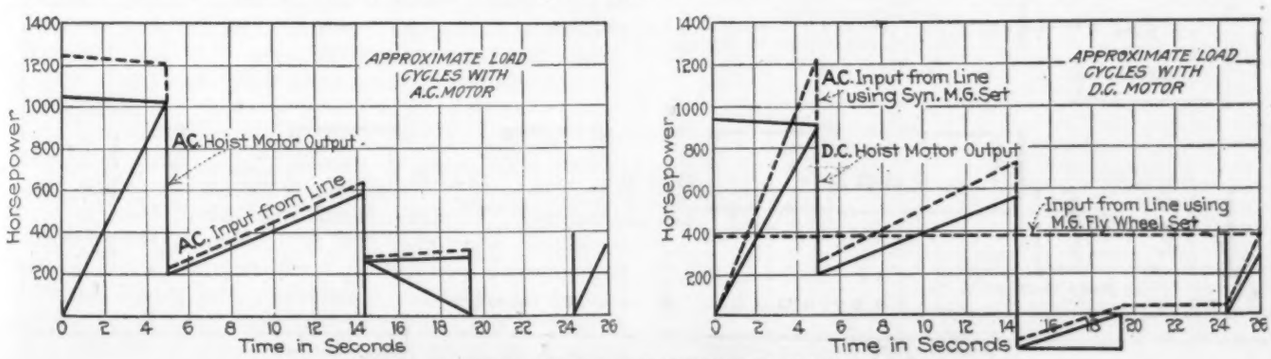

Horsepower
Time in Seconds
APPROXIMATE LOAD CYCLES WITH A.C. MOTOR
A.C. Hoist Motor Output
A.C. Input from Line
APPROXIMATE LOAD CYCLES WITH D.C. MOTOR
A.C. Input from Line using Syn. M.G. Set
D.C. Hoist Motor Output
Input from Line using M.G. Fly Wheel Set

FIG. 6—EFFECT OF DIFFERENT TYPES OF HOIST EQUIPMENT ON THE LOAD CURVE

Sluicing Ashes Shows Low Cost

Method Used in New Denver Station Shows Handling Cost of 16.4 Cents Per Ton of Ashes, or About 2 Cents Per Ton of Coal Fired

BY ALEX W. MORGAN
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ASHES are being transferred from under boilers to a storage pit by means of a sluiceway in the new Lacombe station of the Denver (Col.) Gas & Electric Light Company. The boiler and stoker equipment consists of four 750-hp., class D Connelly boilers equipped with Westinghouse nine-retort stokers and Westinghouse power dumps. The accompanying cross-sectional sketch of the boiler shows the arrangement of the sluice with respect to the ash dumps.

When ashes are dumped they drop directly upon "grizzlies" which will pass pieces of clinker up to 5 in. (12 cm.) in the smallest dimension. All that will pass through the grizzlies is immediately picked up by the water and carried out to the ash sump. The clinkers which do not pass through are first cooled with water sprays and then broken up into pieces that will pass through the grizzlies. The water sprays, consisting of two 2-in. (5-cm.) pipes, run the full length of each side of the ash hoppers. These pipes are drilled with ¼-in. (6-mm.) holes spaced on 3-in. (8-cm.) centers and so placed that a spray of water is directed across the hopper every 1½ in. (4 cm.).

Five 18-in. x 23-in. (45-cm. x 58-cm.) cast-iron side-hung doors are placed in the sides of the ash hopper just above the elevation of the grizzlies. One door is placed on either end and three doors are equally spaced along the front or ash aisle. These doors give sufficient working space to break up the largest clinker.

The sluiceway is 18 in. (45 cm.) wide at the top, 18 in. (45 cm.) deep with a semi-circular bottom and is built of concrete on a 2 per cent grade under all four boilers. Beyond the boilers the water enters sewer tile, 18 in. (45 cm.) in diameter, laid on the horizontal, and discharges into the ash sump. No abrasion of the concrete has been noticed as yet.

The pumping equipment consists of a 5-in. x 6-in. (14-cm. x 17-cm.) American open-runner centrifugal pump, driven through a flexible coupling by a 20-hp., 660-r.p.m., three-phase 220-volt General Electric motor. This pump delivers about 1,100 gal. per minute (4,163 l. per second) against a 25-ft. (8-m.) head and will wash out clinkers weighing up to 15 lb. (6 kg.). The pump has an open runner and the water is recirculated.

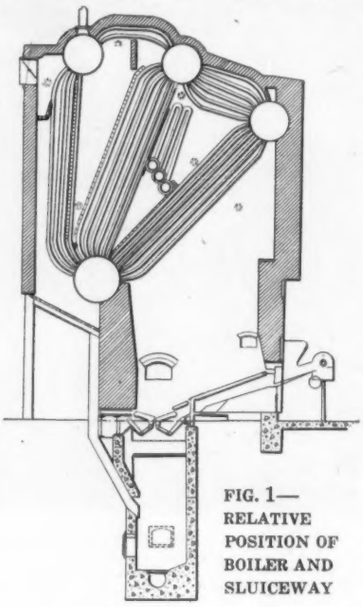


FIG. 1—RELATIVE POSITION OF BOILER AND SLUICEWAY

The sluiceway discharges the ashes into a large hopper 19½ ft. (6 m.) wide by 26 ft. (8 m.) long by 13 ft. (4 m.) deep, from which they are taken by the grab bucket of the coal crane and loaded into railway cars.

This method of handling ashes is the best and most economical with which the writer has come in contact. At the present time the plant is burning 250 tons of coal per day and produces about 33 tons of ashes in twenty-four hours. Three combination men are required, one on each shift, to handle the ashes and look after the feed pumps. About one-third of each man's time is required to handle the ashes. The crane crew consists of two men on two shifts, and each shift spends about one hour removing ashes from the ash sump and loading them on the cars. The cost of handling ashes with this equipment is given in the table.

COST OF HANDLING ASHES IN SLUICEWAY

One ash man, eight hours, at $115 per month	$3.50
Crane crew, two hours at $195 per month	.81
One 20-hp. motor, eight hours at $0.01 per kw.-hr	1.20
One 60-hp. motor, 2 hours at $0.01 per kw.-hr	.90
Total cost per day	$6.41
Cost per ton of ashes removed	$0.164
Cost per ton of coal fired	.02

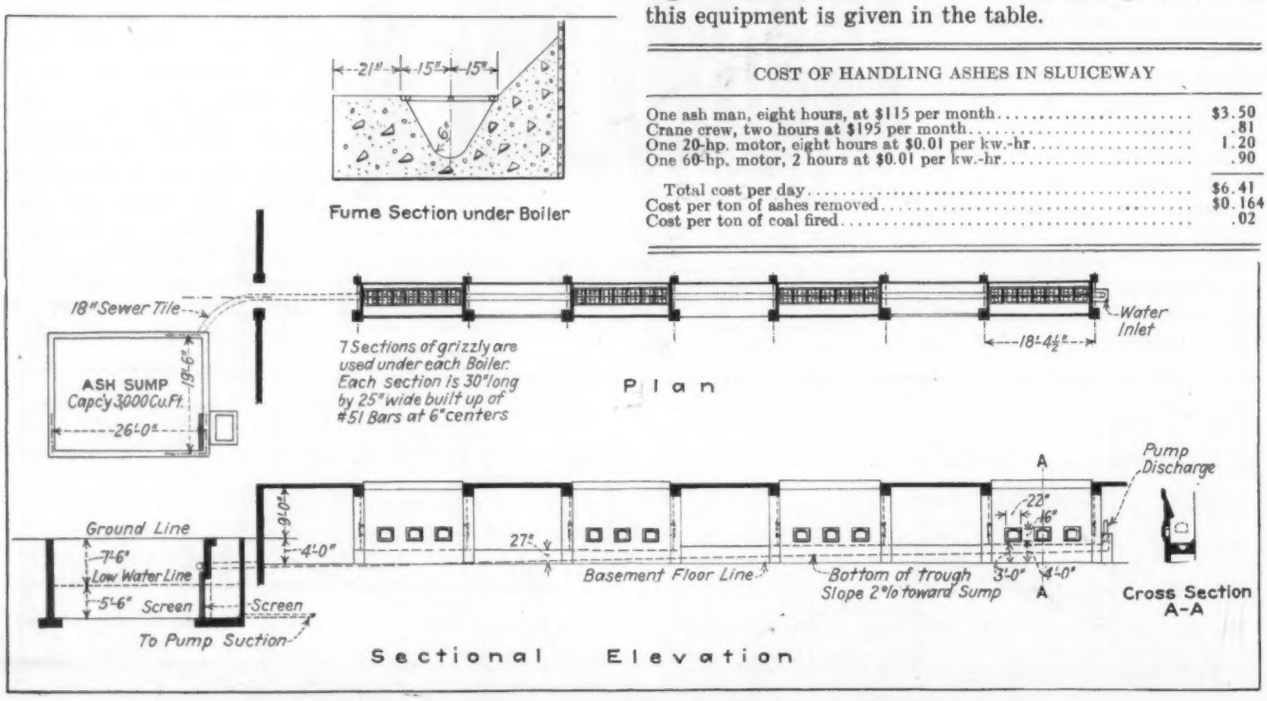
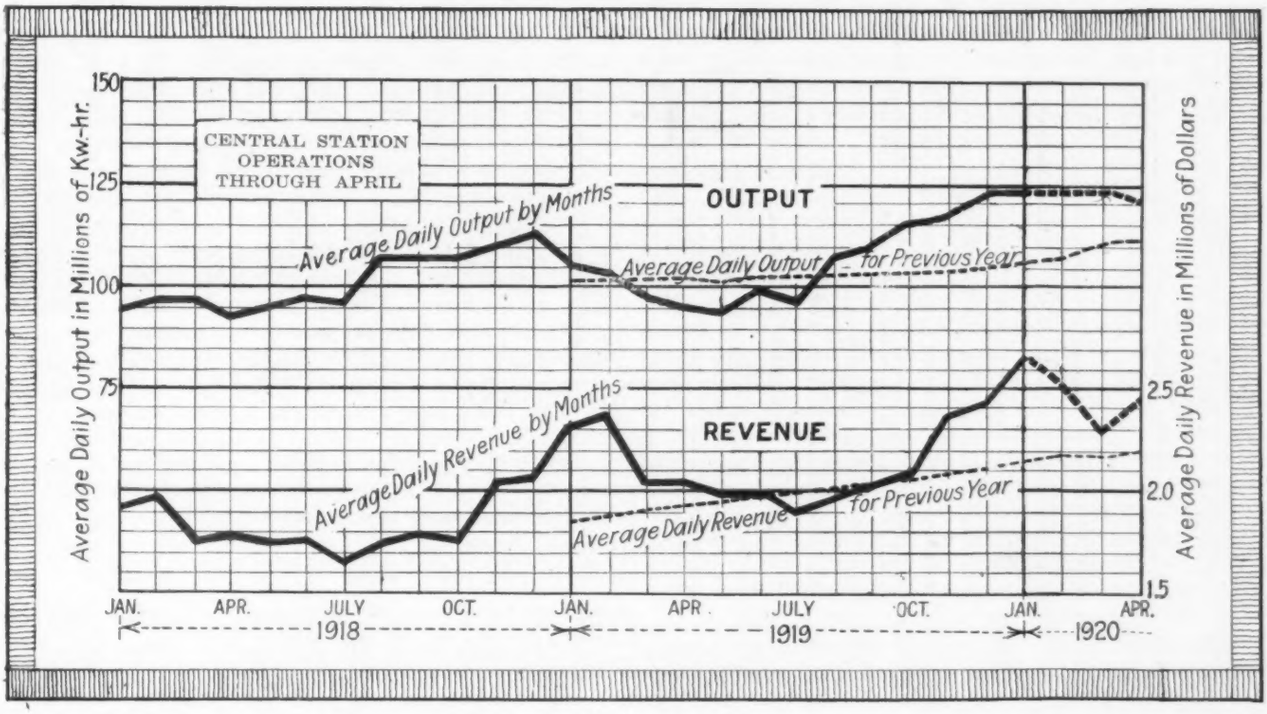


FIG. 2—SLUICEWAY UNDER BOILERS FOR DISPOSING OF ASHES

Outlaw Strike Curtails Power Requirements



THAT central-station operations in April were materially reduced throughout the country as a direct result of the railroad switchmen's strike is indicated in the returns received by the ELECTRICAL WORLD. The reduction in output was also increased by reason of the daylight-saving laws which were put into effect during April in many industrial centers. Despite an average daily decrease of 2,700,000 kw.-hr. under March, the total output for April was 24 per cent larger than that recorded in April, 1919.

Industrial operations in the New England States were seriously handicapped during April by transportation difficulties and local labor disputes. The railroad strike, with its resulting embargoes on freight, affected not only the income of raw materials and the shipment of finished products but also the coal supply. Most centers report that every industry of any importance was well supplied with orders and could have been operated at top speed if raw materials, a requisite amount of help and improved shipping facilities could have been obtained. These insufficiencies, however, taken in conjunction with daylight saving resulted in a drop of 14,400,000 kw.-hr. in comparison with March, as against a drop of only 4,600,000 kw.-hr. during the same period last year.

Delays in delivery of material and fuel caused considerable restriction of industry in the Atlantic section, especially in the northern part, but few plants, if any, were entirely closed as a direct result of the railroad strike. The curtailment in iron and steel production due to the strike was about 17 per cent as compared with the March rate. Several of the large generating companies reported their fuel supply to be near exhaustion, and when the situation eased plans were under consideration for the allotment of power to the more essential industries and for the operation of municipal works and public utilities. The reductions in activities in this section are reflected in central-station operations by a daily average drop of 1,150,000 kw.-hr. in April as compared with March.

In order that the central-station operations in the North Central industrial states and those in the South Central agricultural states may be more clearly defined, the ELECTRICAL WORLD has made a recompilation of the Central States operations and presents two sections for the month of April. These two subdivisions will be continued in subsequent tabulations. The states included in the North Central section are Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota and Wisconsin. The states included in the South Central section are Alabama, Arkansas, Kentucky, Louisiana, Mississippi, Oklahoma, Tennessee and Texas.

TABLE I—CENTRAL-STATION RETURNS FOR TWELVE MONTHS

	Revenue from the Sale of Energy				Kw.-Hr. Output			
	Percentage of Installed Capacities Represented	1919 Thousands	1918 Thousands	Per Cent Increase	Percentage of Installed Capacities Represented	1919 Thousands	1918 Thousands	Per Cent Increase
May	45	$27,795	$24,291	15.5	45	1,306,622	1,314,206	—1.0
June	47	28,175	24,701	14.1	47	1,399,951	1,367,908	2.3
July	44	25,794	22,568	14.1	44	1,309,301	1,281,874	2.0
Aug.	54	32,756	29,006	13.0	54	1,801,836	1,793,706	0.5
Sept.	53	32,344	28,336	14.0	53	1,761,582	1,695,862	4.3
Oct.	55	35,492	30,077	18.0	60	2,175,636	1,987,004	9.0
Nov.	53	37,439	31,927	17.2	58	2,055,428	1,895,693	8.2
Dec.	59	44,125	37,978	16.0	65	2,509,571	2,270,833	10.0
		1920	1919			1920	1919	
Jan.	57	46,614	39,002	19.8	67	2,581,096	2,186,732	18.0
Feb.*	63	45,881	37,502	22.1	69	2,494,764	1,986,493	25.3
Mar.†	65	46,005	36,860	24.2	70	2,694,556	2,089,443	28.9
Apr.‡	65	45,060	36,214	24.1	70	2,554,377	2,060,640	24.0

* Includes estimates for four companies, representing 1.1 per cent of the total installed capacity of all central stations.

† Includes estimates for twenty-five companies, representing 8.2 per cent of the total installed capacity of all central stations.

‡ Includes estimates for fifty-six companies, representing 11.9 per cent of the total installed capacity of all central stations.

TABLE II—CENTRAL-STATION RETURNS BY SECTIONS OVER A TWELVE-MONTH PERIOD

	Month	New England States				Atlantic States				North Central States				South Central States				Pacific and Mountain States		
		Percentage of Installed Capacities Represented	1919 Thousands	1918 Thousands	Per Cent Increase	Percentage of Installed Capacities Represented	1919 Thousands	1918 Thousands	Per Cent Increase	Percentage of Installed Capacities Represented	1919 Thousands	1918 Thousands	Per Cent Increase	Percentage of Installed Capacities Represented	1919 Thousands	1918 Thousands	Per Cent Increase	Percentage of Installed Capacities Represented	1919 Thousands	1918 Thousands	Per Cent Increase
REVENUE	May	70	$3,190	$2,781	14.9	43	$10,817	$9,826	10.1	36	$6,995	$5,826	19.8	35	$1,325	$1,084	22.0	56	$5,468	$4,764	14.2
	June	71	3,317	2,904	14.1	43	10,605	9,537	12.0	39	7,158	6,166	16.0	40	1,599	1,338	19.5	63	5,496	4,767	15.2
	July	70	3,406	2,995	13.7	40	9,320	8,375	12.0	39	7,240	6,121	18.1	38	1,614	1,321	21.9	49	4,214	3,756	12.1
	Aug	74	4,225	3,693	14.4	57	12,174	10,995	11.1	47	9,295	7,924	15.8	39	1,647	1,385	18.4	61	5,415	5,009	8.5
	Sept	73	4,019	3,536	13.6	53	11,429	10,069	13.5	46	9,671	8,278	16.6	38	1,724	1,488	16.0	63	5,501	4,965	10.9
	Oct	72	4,122	3,453	19.1	53	12,684	10,822	16.9	52	11,401	9,484	20.2	38	1,840	1,519	21.1	62	5,440	4,799	13.9
	Nov	71	4,432	3,800	16.2	56	14,738	12,761	15.7	44	10,541	8,689	21.2	39	2,063	1,694	21.8	63	5,665	4,983	13.9
	Dec	73	4,908	4,254	15.1	57	15,926	13,806	15.8	49	11,660	9,833	18.3	44	2,496	2,070	20.0	77	9,135	8,015	14.2
			1920	1919			1920	1919			1920	1919			1920	1919			1920	1919	
	Jan	78	5,635	4,718	19.8	59	17,659	14,625	20.9	51	12,885	10,799	19.6	53	3,047	2,538	19.9	75	7,388	6,322	16.1
	Feb	82	5,354	4,368	22.1	61	17,245	14,343	20.4	55	13,191	10,403	26.0	53	2,949	2,360	24.7	79	7,142	6,028	18.3
	Mar	82	5,136	4,044	27.0	63	17,703	14,326	23.9	57	13,113	10,462	25.4	54	2,910	2,287	27.2	79	7,143	5,741	24.2
	April	82	5,097	3,957	28.1	63	17,212	13,945	23.5	57	12,643	10,123	26.0	54	2,952	2,181	35.2	79	7,156	6,008	19.1
KW.-HR. OUTPUT			1919	1918			1919	1918			1919	1918			1919	1918			1919	1918	
	May	70	120,856	120,908	−0.1	43	413,043	430,729	−3.9	36	349,890	338,648	3.2	35	40,777	38,877	5.0	56	382,056	385,054	−0.9
	June	71	127,260	119,217	6.7	43	408,335	419,060	−2.5	39	364,552	336,902	8.0	40	53,990	49,520	8.1	63	445,814	443,209	0.5
	July	70	141,551	130,393	8.2	40	373,105	378,053	−1.5	39	371,425	355,664	4.5	38	56,945	52,501	8.1	49	366,275	365,263	0.1
	Aug	74	161,431	153,266	5.1	57	640,616	662,120	−3.2	47	496,745	460,360	8.0	39	58,991	53,231	10.2	61	444,026	464,729	−4.2
	Sept	73	153,837	146,209	4.5	53	610,254	610,179	0.1	46	515,519	463,929	11.5	38	58,316	54,838	6.3	63	423,656	420,707	0.5
	Oct	72	162,859	142,326	14.4	53	694,584	659,859	5.3	67	815,284	709,665	15.3	38	67,155	56,742	18.5	62	435,754	418,412	4.1
	Nov	71	153,171	140,240	9.2	56	724,667	707,347	2.4	60	686,486	597,855	14.9	39	68,352	59,507	14.7	63	422,812	390,744	8.2
	Dec	73	180,493	152,304	18.0	58	803,165	733,222	8.9	67	825,313	713,959	15.8	44	88,658	73,728	20.1	77	611,942	597,620	2.5
			1920	1919			1920	1919			1920	1919			1920	1919			1920	1919	
	Jan	78	207,158	159,773	29.8	60	853,057	717,303	19.2	69	841,841	731,758	15.2	56	140,736	117,677	19.9	75	538,304	460,221	16.2
	Feb	82	187,264	148,103	26.2	62	809,865	672,836	20.1	73	858,939	663,523	29.4	56	130,473	98,098	33.0	79	508,223	403,933	26.1
	Mar	82	198,603	148,512	33.5	64	900,615	712,895	26.1	74	905,829	696,324	30.0	56	137,514	102,771	34.1	79	551,995	428,941	28.6
	April	82	186,842	144,744	29.2	64	848,266	673,094	26.0	74	849,521	685,399	24.0	56	135,140	99,877	35.2	79	534,608	457,526	16.9

The effects of the railroad strike were probably most severely felt in the manufacturing centers of the North Central States. In the Detroit district the coal supply was so short that central-station power to factories was very greatly curtailed. It was more than a week before it was possible to accumulate sufficient coal to give more than a minimum supply of energy. At the end of April plants in this locality were operating at only about 40 per cent capacity for want of sufficient power. Other sections of the North Central States report large curtailments in production and consequent less demand for power. Average daily power demands for this section were 1,250,000 kw.-hr. less than in March.

Labor troubles did not affect industrial activities in the South Central States beyond the placing of embargoes by local railroads while the strike was on. The central-station operations in the section for April show a small increase over those of March.

Strikes of large extent in the mining districts of Montana, Utah and Nevada curtailed power requirements by the mining industry of the Mountain States. The railroad strike was also severely felt by all lines of industry in the Mountain and Pacific States, but despite these adverse industrial conditions and a decreased demand for energy for illumination purposes, the average daily central-station output in this section was 19,000 kw.-hr. more than during March.

FORTUNATELY *for the nation, success dies hard. The great business combinations have not yet been destroyed. If the government policy regarding them had been as completely successful as in the case of the railroads, our ability to meet the emergency produced by the war would have been so much reduced that the assistance we could have rendered the Allies would have been negligible.*—PHILIP CABOT.

School Lighting Should Give 6 to 12 Ft.-Candles

TO INSURE ample light for the student with defective eyesight, and with the hope of increasing the speed of the school work generally, as has been done in industrial work, lighting intensities at least as high as the maximum given in the code should be used. It is doubtful whether the intensities hitherto recommended for school lighting are high enough to reduce eye strain to a minimum. These intensities have corresponded with the lower values of the Illuminating Engineering Society code, which are as a minimum for "ordinary practice" from 2 to 6 ft.-candles (21.5 to 64.5 lumens per sq.m.) for various rooms, and have a range of maximum values from 4 ft.-candles to 12 ft.-candles (43 to 129 lumens per sq.m.).

An attractive installation is desirable. The choice usually lies, therefore, between semi-indirect or indirect fixtures and high-suspended direct lighting with some form of glass reflector. With direct units the difficulty of eliminating glare increases as the required intensity of illumination increases, but they have the advantage of giving about twice as much light for the same expenditure of energy as can be obtained from either indirect or semi-indirect units.

Glare due to the reflection of bright light sources from blackboards, polished table tops and glazed paper should be carefully avoided. The lower part of the walls as high as the top of the blackboard should be finished in a medium tint restful to the eyes. This is especially important in classrooms to avoid contrast with blackboards. A good system of lighting blackboards is by concealed lamps in a hood along the top of the board. These suggestions were given in an address before the Chicago Section of the Illuminating Engineering Society by Prof. F. C. Caldwell, chairman education committee.

A. I. E. E. Technical Committee Reports

Transmission at 220 Kv. Continues to Hold Chief Interest—Extensive Use of Electricity in Heat Treating and New Luminous-Arc Lamps Considered—Developments of Code for Ship Installations

FOLLOWING a plan developed at the 1919 A. I. E. E. convention, Wilfred Sykes, chairman of the board's committee on technical activities, suggested to the various 1920 technical committees that their reports "should cover notable installations or developments during the year. Several of the committees (notably those on transmission, meters and iron and steel) have made a good start to accomplish this purpose, but in other cases the lack of time or a belief that the old plan was more desirable has prevented the general adoption of the new plan.

Thirteen committees out of sixteen reported—electrical machinery, electrochemistry and electrometallurgy, electrophysics, industrial and domestic power, instruments and measurements, iron and steel, lighting and illumination, mines, power stations, protective devices, telegraphy and telephony, traction and transportation, and transmission and distribution. The gist of their reports follows. No reports were submitted by the committees on economics of electric service, education or mines.

Live Problems in Transmission and Distribution

The committee on transmission and distribution has devoted the major portion of its report to the subject of extra high voltage for possible interconnection and super-power plant development and to improvements and tendencies in underground cables and construction, as outlined by its chairman, E. B. Meyer.

Developments of trunk transmission at such a voltage as 220 kv. would involve new problems arising from the high voltage, the large amount of power involved and the high service standards which the importance of the transmission would demand. However, it was said that these problems differ in degree but not in character from those which have satisfactorily been handled in present practice. Regarding transformers in large units for 220 kv., it was stated that no radical departures are involved in either design or construction, and for oil circuit breakers it was said that satisfactory designs have already been worked out. For such high-voltage installations the policy should tend to extreme simplicity of layout and stanchness of equipment. One feature of such policy would probably be the omission of arresters or similar protective equipment. It appears that these would be neither needed nor effective at this high voltage.

There appears to be some doubt, however, as to whether present practice in line insulators can be extended without considerable modification to 220 kv. over the string, and whether suitably shaped electrostatic shields can be used at the ends of the strings. It was said that the mechanical problem is the serious one when it comes to supporting, with adequate margins of safety, the extreme loads which would be called for by 220-kv. service, due to the large size of conductor, the long spans, etc. In view of these limitations of the present type of high-voltage insulator the need for an improved or radically different design for high voltages has been strongly emphasized. Some of the insulator manufacturers appear to be making extensive investigations and experiments in this field.

It was said that there have been marked improvements in the manufacture of underground cables so that the carrying capacity of the cables manufactured today is materially greater than that of cables manufactured a few years ago. The principal improvement is the reduction of dielectric loss at relatively high temperature. This has been accomplished principally as the result of a thorough study of the properties of impregnating compounds.

It has been the aim of the iron and steel industry committee, as reported by W. F. James, chairman, to report as a foundation the present status of electrical application to the iron and steel industry, upon which subsequent committees might base annual reports showing recent progress. Regarding the status of iron ore smelting in electric furnaces, it is said that pig iron of high grade can be made in the electric furnace and is made in considerable quantities, but only at localities that combine the conditions of having ore and charcoal accessible to dependable low-cost electrical energy, not exceeding $12 to $15 per horsepower per year.

The Cottrell system of electrical precipitation has been applied in two instances to the cleaning of blast-furnace gas. The advantages are such that this equipment is likely to become common among the blast furnaces. A typical installation put into service during 1919 takes three-phase, 60-cycle, 220-volt energy from the system, two 25-kv. transformers in open delta being ample for the entire power requirement.

Carbon-resistor type furnaces have been successfully developed for steel treating. Advantage is invariably taken of the possibility of making these furnaces automatic, both as regards the cycle of temperature treatment and the charging and discharging.

Some New Instruments Have Appeared

S. G. Rhodes, chairman of the committee on instruments and measurements, reports a few new developments in measuring devices, some standardization and adaptation to commercial use of the designs dictated by the war. There has been some difficulty in the production of standard and accepted lines of apparatus on account of labor troubles and the lack of materials.

It was said that practically all the companies manufacturing watt-hour meters and demand devices reported the completion of experimental models, finished designs or actual production of devices for measuring kilovolt-ampere-hours and demand devices for measuring the demands of kva., kw. and power factor. These various devices may make the measurements separately or simultaneously on a single record.

One company reported the development of an automatic potentiometer and automatic Wheatstone bridge, both used for recording or controlling processes, or a combination of the two. These automatic equipments are supplied for the control of chemical and electrochemical processes, and some installations of them are in actual use. For chemical and electrochemical work the automatic Wheatstone bridge can be operated on a commercial 60-cycle alternating-current circuit, and a special alternating-current galvanometer has been especially designed for this equipment.

The recording or indicating potentiometer when used in connection with thermocouples produces a satisfactory and accurate record of temperature, it was said. The measure of temperature is, of course, directly related to design and operating requirements of electrical apparatus, and these devices serve to analyze the daily or weekly cycles of thermal performance of cables, transformers, turbine-generators, or in fact any of the various commonly used types of apparatus in generating and distribution systems.

Protection for Potential Transformers

Reporting for the protective devices committee, D. W. Roper, chairman, said that an unusually large percentage of the larger operating companies have experienced severe system disturbances, and in some cases the behavior of the protective devices was an important factor in the disturbances.

It was said that in the last few years there has been a marked improvement in the design of reactors such as methods of winding to reduce eddy currents and improvement in structure to increase the insulation strength and to work the copper to the best advantage.

The committee reported that one of the larger companies in New York had made elaborate and complete short-circuit tests on potential transformer fuses installed with and without protective resistors in series. Following these tests a number of companies have adopted the standard practice of installing protective resistors in series with the potential transformer fuses which are connected to their high-tension buses. Other companies, it is said, are using a different type of fuse which has given excellent results in service and does not require the use of a protective resistor in series.

Progress in Lighting and Illumination

Summarizing the report of the lighting and illumination committee, under the chairmanship of C. E. Clewell, important developments during the last year were stated as follows: (1) A widespread recognition of good lighting as an important aid to manufacturing. (2) The increasing use of the foot-candle meter as a means of checking illumination intensity in various parts of a lighted room. (3) Progress of industrial lighting codes. (4) Progress in automobile lighting regulations in several states. (5) Development of the bowl-enameled gas-filled lamp to give better diffusion. The latest lamps of this type have a feathered edge of the enameling to prevent a sharp "cut-off" line. (6) The proposal of a plug outlet for permitting the convenient change of ceiling and wall fixtures. (7) The increasing tendency on the part of fixture manufacturers to make ready-to-hang types of fixtures. These fixtures are principally for commercial and industrial lighting, but there is also some tendency to invade the residence lighting field. (8) Progress in the enforcement of the industrial and automobile headlight codes. (9) An important development in street lighting of a unit which contains two lamps (in one type, one 1,000-cp. and one 250-cp.). By means of a relay located in the casing of the fixture the 1,000-cp. lamp will be extinguished at midnight and the 250-cp. lamp lighted.

Luminous arc-lamp efficiencies have been increased by the compounding under high pressure of the ingredients of the electrodes. It is reported that by this means 30 to 40 per cent more light is produced than with the previous standard electrodes, with at least equal life. For the same light as formerly increased life of the electrodes is expected.

The compilation of a set of rules for electrical installations on shipboard was started last year and was carried to completion by the marine committee, of which Arthur Parker is chairman this year. These rules will be published in pamphlet form. It was said that the rules were most complete, covering practically every phase of the electrical field as applied to ship work. Much of the credit for this work was due to the ship installation committee, under G. A. Pierce.

One of the ideas brought forth during the year was the consideration of terminal facilities at marine piers. This is more or less a new activity, as very little has been done thus far to facilitate the handling of cargoes at these terminals. The field is large and therefore worthy of a considerable amount of thought.

Telephone and Telegraph

Most important progress has been made by the committee on telegraphy and telephony during the past year in the standardization of telegraph and telephone practice of the railroads of this country and Canada, according to Donald McNichol, chairman.

The activities in both the power and the communication fields since the war have demanded renewed close attention to the study of inductive interference. The growing use of arc furnaces, which usually produce great distortion of wave form, has given rise to serious problems in noise interference prevention. The methods of overcoming interference with communication circuits from normal conditions on adjacent power circuits have not been so well developed as the methods of overcoming disturbances from the normal operation of power circuits.

The progress in radio communication in the past year has been more in the nature of a consolidation of the scientific advances of the war time than in the nature of an entry into new fields of radio signaling.

The industrial and domestic power committee, under the chairmanship of A. G. Pierce, has continued its earlier plan of work without change or modification. Eleven sub-committees are analyzing electrical power applications in eleven different branches of industrial activity. Some of their reports will be available shortly.

In presenting his report, B. A. Behrend, chairman of the committee on electrical machinery, pointed out that the progress of the art in electrical machinery was best traced through the papers which had been solicited. He therefore thought it unnecessary to deal again with subject matter comprehensively presented in the papers. The activities of the committee were in great part directed toward the general subject of super-power stations for the Eastern coast states.

It was thought that the best activity of the committee on electrochemistry and electrometallurgy would be to foster joint meetings with the American Electrochemical Society such as that held in Boston in April, 1920, said F. A. J. Fitzgerald, chairman.

After reviewing the papers which had been brought out by the committee on power stations, Philip Torchio, chairman, recommended the following subjects for consideration during the coming year: (1) Safe maximum limit of operating capacity for each section of bus; (2) reactive component dispatching; (3) auxiliaries in steam and hydro-electric plants; (4) fighting generator fires; (5) trend of modern power station design.

Readers' Views and Comments

Boiler Steam Pressures and Superheat

To the Editor of the ELECTRICAL WORLD:

SIR: The subject of high steam pressure and moderate superheat as against moderate pressure and high superheat has been discussed to considerable extent in the last few years, and it is one that is of great importance. The prime movers committee of the National Electric Light Association has been inviting a discussion of the subject, and the writer was greatly interested in the statements made by W. F. Durand and C. H. Delany, whose article on "Steam-Electric Generation in the Far West" was printed in the May 15 issue of the ELECTRICAL WORLD.

I beg particularly to refer to the table of comparative figures on page 1127, which purports to prove the superiority of the high-pressure and moderate-superheat combination. The authors derive the energy available for both combinations from adiabatic expansion within the steam conditions given by initial pressure and superheat on the one side and condenser pressure on the other, and very correctly prove that the available energy of adiabatic expansion within those limits is greater for the high-pressure combination by 3.83 per cent; but in making the next step and calculating the work in B.t.u.'s abstracted from the steam by the turbine, they assume the same efficiency of 75 per cent for both the moderate and high-pressure combination, an assumption which would seem to be unjustified in view of the fact that the bucket friction and windage losses of a steam turbine increase with the density of the steam. In fact, it seems to the writer that with the assumption of equal turbine efficiency in both cases the authors of the article have entirely disregarded the most important influence of steam superheating upon turbine operation.

At least one of the big steam-turbine builders guarantees decreases of water rate through superheating of about 1 per cent for about every 11 deg. of superheat, which means that such a turbine, operating with 200 lb. pressure and 200 deg. superheat, must use about 18 per cent less steam than a turbine operating at that pressure with saturated steam. A comparison of the available energy of adiabatic expansion between 200-lb. pressure saturated steam or 200-lb. pressure, 200 deg. superheat on the one side and 1-in. absolute on the other results, however, only in a difference of 11.45 per cent, so that it is clear that a comparison on the basis of the energies available from adiabatic expansion alone does not solve the problem. In fact, all of the steam-turbine builders have for years been aware of the fact that the density of the fluid in which buckets and disks revolve has a very considerable bearing upon the turbine efficiency, and the writer believes that when tests are available they will show the conclusions of Messrs. Durand and Delany to be reversed.

At least, it is likely that the turbine efficiencies will be unfavorably affected by the higher mean steam densities which will be encountered within the turbines at the higher pressures. The problem is a rather complicated one, inasmuch as we cannot actually obtain adiabatic expansion in steam turbines, and because the friction and windage losses themselves affect the process of expansion, the heat of friction being absorbed by the steam itself. Nothing short of actual tests will throw sufficient light on the subject, but a great many facts which we now have about the performance of steam turbines seem clearly to favor the high superheat combination.

Another problem the solution of which bears upon this same question, and one about which very little has been said, relates to the efficient production of the high superheat. It is most important that superheaters be so constructed and combined with boilers that the desired amount of high superheat shall be obtained with a minimum of fuel consumption, or with as high a combined efficiency of boiler and superheater as possible.

R. M. OSTERMANN,
Chicago, Ill. Locomotive Superheater Company.

Operation of Fuel-Oil Pumps

To the Editor of the ELECTRICAL WORLD:

SIR: In the article on "Steam-Electric Generation in the Far West," which appeared in the ELECTRICAL WORLD for May 15, 1920, the authors, W. F. Durand and C. H. Delany, touched only slightly upon the oil pump and how it functions in the standard steam power-plant installation where oil is used as fuel. Since an inquiry on this point has come to the attention of the writer, the following information will be of considerable interest as an addition to the original article.

Fuel oil, as a rule, is taken from the supply tank, leading to the burners, by the oil pump. The type of pump ordinarily used for this purpose is the usual duplex steam-driven reciprocating pump. The pump must have brass valves and metallic or other packing that will not be affected by the oil. The pump should be provided with a large air chamber to prevent pulsation of oil pressure due to the strokes of the pump. It is customary to install the pumps in duplicate so that one may be kept shut down at all times ready to go into service immediately if the other has to be shut down for repairs. The pumps should be of sufficient size to deliver the maximum quantity of oil required when operating at comparatively slow speed—not more than fifteen to twenty strokes a minute. The pump must not be set too high above the oil tank, for oil cannot be raised by suction as high as water. The maximum suction lift permissible is approximately 16 ft.

The oil pumps should be provided with a pump governor for the purpose of maintaining a steady oil pressure. One well-known type of pump governor consists of a double-ported throttle valve placed on the steam line supplying the pump. The valve stem is attached to a spring-loaded piston which is actuated by the oil pressure. If the oil pressure increases, the valve partially closes, thus slowing down the pump. If the oil pressure drops, the valve opens wider and the pump is speeded up. Any predetermined pressure may thus be maintained by adjusting the spring.

C. H. DELANY,
Steam-Power-Plant Specialist.
Pacific Gas & Electric Company,
San Francisco, Cal.

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Table Shows Coal Consumption for Different Grate Speeds

TO OBTAIN hourly readings of coal consumed, the travel of the chain-grate stokers is used in conjunction with the accompanying table by a Missouri power company. There are two sizes of stokers installed, those with grates 9.5 ft. (2.9 m.) wide, feeding 500-hp. Connelly boilers, and class "O" Stirling boilers of the same rating, and others 11.5 ft. (3.5 m.) wide, feeding 500-hp. class "S" Stirling boilers. For each of these widths the table gives the coal consumption for different grate openings from 4 in. to 7.5 in. (10 cm. to 19 cm.). The amount of coal is given for a travel of the grates equal to one chain link of 10 in. (25.4 cm.). Knowing this coal consumption, it is easy to compute the pounds per kilowatt-hour from the watt-hour-meter readings and to calculate evaporation per pound of coal from the readings of a Cochran V-notch water meter.

COAL CONSUMED PER 10 INCHES OF TRAVEL (LINK) OF CHAIN GRATES.

Gate Opening, in Inches	Pounds with Grate 9 ft. 6 in. Wide	Pounds with Grate 12 ft. Wide
4	132	...
4.5	148	180
5	164	206
5.5	181	227
6	197	248
6.5	214	268
7	230	289
7.5	246	309

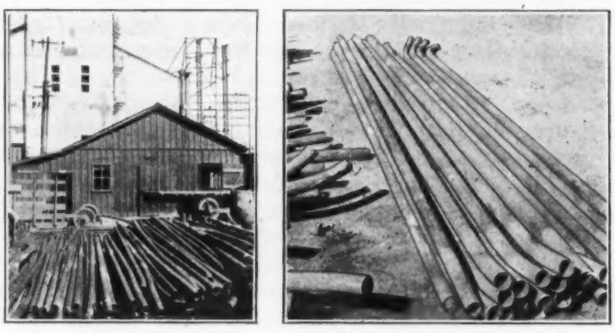
Empire District Electric Co. FRED M. RICHARDS,
Joplin, Mo. Chief Engineer of Power Plants.

Rehabilitating Standby Plants

TO MAINTAIN its output in the face of the water shortage in the mountain streams and the prospects of a season of light precipitation, the Southern California Edison Company has put back into operation a number of small steam plants which had been abandoned on account of their high operating cost. On plants of this character little or no money is spent for upkeep, but corrosion and deterioration go on just as if the plant were in operation, and consequently when such plants are put into operation many unforeseen difficulties are encountered. Leaks caused by the corrosion of boiler, superheater and condenser tubes was one of the most general troubles which had to be remedied in these California plants. Other important work was overhauling turbine valves and drying out electrical equipment.

The largest and most interesting of these rehabilitated plants is the 10,000-kw. Los Angeles No. 3 station, which has not been in continuous operation for about six years. The equipment of this plant consists of two 2,000-kw. Curtis vertical turbines and one 6,000-kw. Westinghouse Parsons turbine, eight 500-hp. Stirling boilers equipped with Niclausse superheaters, and seven 700-hp. Stirling boilers equipped with B. & W. superheaters which have one 24-in. (61-cm.) drum and one 36-in. (19-cm.) drum, with double tube-sheets and six rows of forty-six tubes, each about 12 ft. (4 m.) long and 2 in. (5 cm.) in diameter, extending between the drums.

The tubes in these boilers were badly corroded from the inside, and to put them in reliable operating condition it was necessary to renew the front eight rows of tubes in the 500-hp. boilers and the front seven rows in the 700-hp. boilers. The cost of new tubes would be excessive for a standby plant to be operated only a short time. However, it happens that during the past six months this company has been making similar renewals of tubes in its boilers at the Redondo plant. The tubes used at the Redondo plant have the same diameter as those at the Los Angeles No. 3 station but are two feet longer. Since the faults in the tubes removed from the Redondo station are principally due to outside corrosion near the end of the tube where it enters the mud drum, the best of these tubes are selected, the faulty ends are cut off and the tubes are rebent to fit the boilers at the Los Angeles plant. The cost of cutting and rebending these tubes is about $1 each, and the junk value of the tubes is about the same; hence a tube practically as good as new is obtained at an expenditure of approximately $2. About 3,000 of these tubes are being reclaimed.



CORRODED ENDS OF OLD BOILER TUBES (LEFT) CUT OFF AND TUBES REBENT (RIGHT) FOR SHORTER BOILER

The Niclausse superheaters in the 500-hp. boilers had deteriorated beyond repair, hence the entire superheaters have been cut out of service. On account of difficulty in removing the superheaters from the boiler settings, the drums have been left in place, but the tubes have been cut off with an oxyacetylene torch in order to facilitate the work of renewing the boiler tubes. Much difficulty is encountered in keeping the tubes tight in the superheaters of the 700-hp. boilers on account of the double tube-sheet. This sheet reinforcing, which is on the inside of the superheater drum, is made of ½-in. (63-mm.) metal and extends over one-quarter of the circumference of the drum. There is a space of 1½ in. (3.8 cm.) between the two sheets and the tubes

are expanded into both sheets. The tubes corrode badly between the two sheets, and owing to the difficulty of expanding the tubes into the main sheet, it is almost impossible to prevent leakage of steam at this joint. To eliminate this trouble the inside sheet and the ends of tubes protruding through the main sheet have been cut off with an oxyacetylene torch, and the tubes are expanded into the main sheet only.

The turbine valves and condensers were thoroughly overhauled before being placed in operation and a large number of condenser tubes were renewed. The blading of the 2,000-kw. turbines was inspected and found to be practically in as good condition as when new. This is very remarkable when it is considered that these turbines are fifteen or sixteen years old, have never been rebladed and have had hard service. A life of four or five years for blading of modern turbines is considered long. The generators of these units were dried out and put into service, carrying full load without giving the slightest trouble.

The galvanized-iron distributing troughs on the cooling tower were also very badly corroded. Repairs were made by reinforcing corroded portions of the iron troughs with wooden troughs. By this procedure the cost of repairs was kept down to about one-tenth the cost of replacing the troughs as originally built, and they are almost as effective as new troughs.

By means of these and other economical methods of repair this plant has been placed in good condition at a very reasonable figure. It will be operated until more modern steam units are installed and until additional hydroelectric plants now under construction will be completed.

J. W. ANDREE,
Dept. of Generation. Assistant Superintendent.

Shocks Received Through Defective Rope

INVESTIGATION of a coil of rope through which workmen of the Dayton (Ohio) Power & Light Company had received shocks while holding it over a live line disclosed that a small steel wire was made up with the strands of the rope. This coil of rope was purchased from the usual supply house and was thought to be the same rope as had been used for some time. However, as the groundman of a line crew took hold of the rope hanging from a 6,600-volt line he was severely shocked and slightly burned. In another case a 6,600-volt line was short-circuited by throwing the rope over the line, and in a third case when a street-light patrolman attempted to lower a street lamp his hand line, dragging over a railway feeder, severely shocked him. After the occurrence of these accidents samples of all ropes in supp'y and in use by the line crews were called in and received a high-tension test. All of the ropes from one particular coil broke down at from 500 volts to 7,000 volts per foot, while other samples withstood 36,000 volts per foot. This coil was immediately taken out of service and upon investigation was found to contain a small steel wire, about 0.007 in. (0.175 mm.) in diameter. This wire was difficult to find, but by unraveling several inches of the rope and burning it off it was easily seen. The rope contained the usual marker, but by mistake the strand containing the steel wire which is used for another style of rope had also been included in the coil.

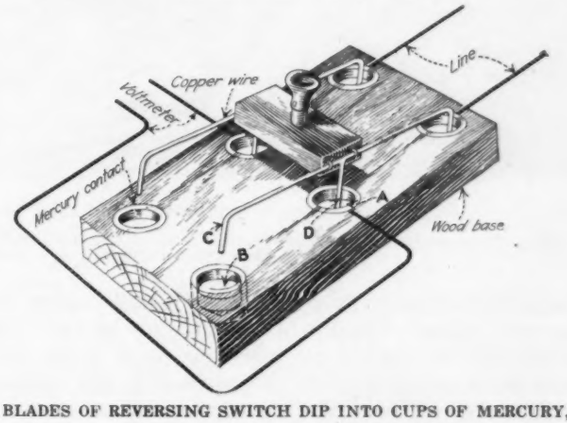
To prevent a recurrence of this trouble, the company has issued orders that all rope purchased be subjected to a high-potential test before being placed in stock.

Thrust-Bearing Trouble Cured by Increasing Oil Pressure

CONSIDERABLE trouble with the thrust bearing on a 7,500-kw. horizontal turbine at the Flint (Mich.) plant of the Consumers' Power Company was overcome by changing the bearing so that the oil supply was received from the hydraulic governor pump instead of the main bearing-supply line. This trouble was at first attributed to the oil holes in the bearing having been made too small, and they were then made larger. As this did not correct the trouble, the style of the bearing was changed without improving conditions. After a more careful study it was found that the trouble was due to dirty steam, which loaded the buckets with mud. Although this mud was periodically removed from the buckets, the bearing trouble continued. Therefore it was recommended that a higher oil tension be put upon the thrust bearing. Accordingly the piping was changed so that the supply of oil was taken from the hydraulic gear instead of the line serving the rest of the bearings. With this connection the oil pressure at the bearings was more than doubled. Since the change the bearing has given no trouble, and apparently the difficulty has been overcome.

Reversing Switch for Meters Which Has 190 Microhms Resistance

AS AN ordinary reversing switch used in the potential circuit of a test table for calibrating instruments was found to give unsatisfactory results, owing to poor contact at the hinged part of the blade, a switch with mercury contacts was employed to prevent the trouble. To hold the mercury, six small cups were made by drilling out solid ¾-in. (2-cm.) brass rod. These cups were set into a wooden base as shown, and the connections were made on the back of the base. Lengths of No. 8 bare copper wire were bent as shown to form the "blades" of the switch. The inside of the small



BLADES OF REVERSING SWITCH DIP INTO CUPS OF MERCURY, GIVING LOW CONTACT RESISTANCE

brass cups was amalgamated by placing a solution of mercurous nitrate in the cups and passing an electric current through it. In a similar manner the contacts on the copper wire were amalgamated. This prevents the mercury globules from adhering to the contacts when the circuit is opened and permits of better contact in the case of the brass cups. A few drops of oil placed on top of the mercury in each cup prevents rapid oxidation of the mercury.

The center posts rest on the bottom of the center cups, the switch being rocked on these points. With this method of supporting the blades the circuit is always closed on one side or the other. It was not necessary in this instance to hold the circuit open, but if it were necessary, the blades could easily be supported on small pedestals cut out of strip brass or copper.

The resistance between the points *A* and *B* on the edges of the cups, including the contact resistance of the points *C* and *D*, was measured and found to be 190 microhms. This resistance is so low that it will not affect the reading of meters.

E. C. SOARES,
Ampere, N. J. Electrical Engineer.

Knockdown Conduit Work in Substation Construction

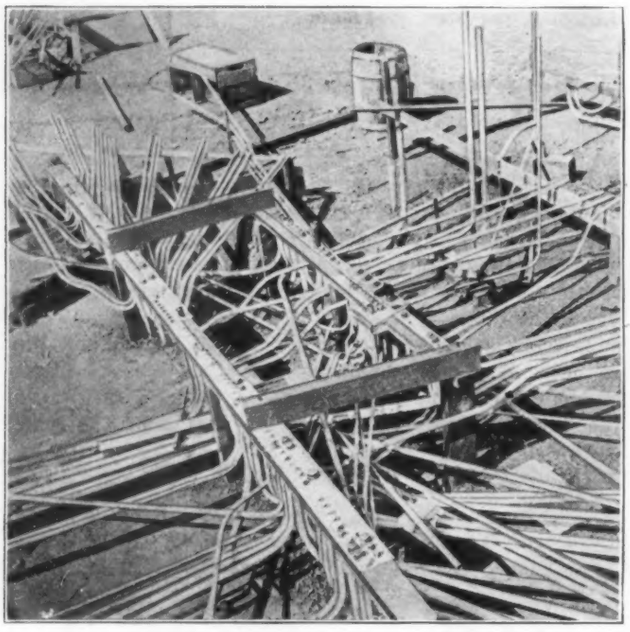
IN THE construction of the new Torrance substation of the Southern California Edison Company a method of installing conduit was developed and worked out which will no doubt have a marked effect in reducing the cost of building the many new stations which the Southern California Company must install during the next few years. Usually in installations of this kind the conduit is worked up piece by piece, each piece being fitted carefully in its proper place in the building as the work progresses. This method makes construction of the building proper very slow as the conduit reaches into all parts of the structure and the concrete, or other building material, can only be placed as the conduit runs are laid out and installed.

At a short distance from the actual substation site an outline of the substation foundation was made and the location of the switchboards, the switches, the metering transformers and all the other electrical equipment was indicated. These were taken from the plans of the station and placed in position to exact scale. This marks the first similarity to a manufactured product—the assembly of parts built to scale. Templates for the switchboards and control circuits were then built and placed in their proper relative positions in the dummy building.

These required careful spacing and alignment and also exact leveling so that the finished product would fit exactly. The conduit was then carefully bent and fitted to the templates in the dummy structure, after which each part was numbered to correspond to its position in the template between which it ran.

All the above work was done in advance of the starting of work on the building proper in order that there might be no delay after the latter began. The foundations of the station were then poured. As this work proceeded the templates retaining the prepared conduit were torn apart and the pieces removed and placed in their location in the substation, as indicated by their markings.

One of the remarkable features of this installation is the fact that more than 370 separate pieces of conduit were bent and placed in position in the templates with the use of almost no threaded bends and elbows. This method has two great advantages—first, wire can be pulled through longer runs without pullboxes, and, second, there remain fewer joints into which moisture can leak.



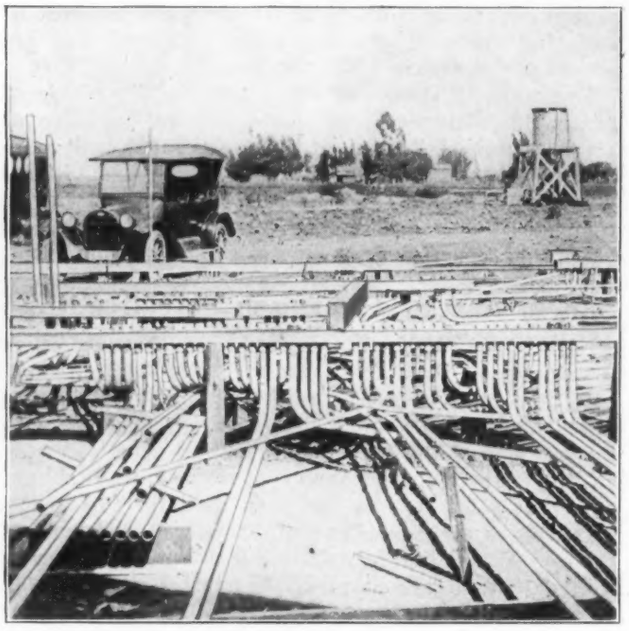


FIG. 1—CONDUIT FITTED TO TEMPLATES. FIG. 2—REASSEMBLED CONDUIT READY FOR POURING

Before construction work began on the substation the conduit was fitted by means of templates laid out from the plans. Each piece was numbered and reassembled as the building proceeded.

The installation at Torrance station included more than 14,000 ft. (4,200 m.) of conduit. Of this quantity only about 2,000 ft. (600 m.) was used for power circuits. All the remainder—nearly 2½ miles (4 km.)—was necessary for the control circuits.

A part of the substation after the conduit was reassembled is shown in Fig. 2. In the right center of the illustration is the switchboard location with the maze of conduit radiating to the feeder switches and other locations. Concrete was poured immediately after the photograph was taken.

Southern California Edison Company, Los Angeles, Cal.

G. C. HECKMAN, Electrical Construction Foreman.
E. R. STAUFFACHER, Protection Engineer.

Industrial Applications

The Economical Utilization of Electrical Energy
in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Rewinding a Motor with Odd Coil Groupings

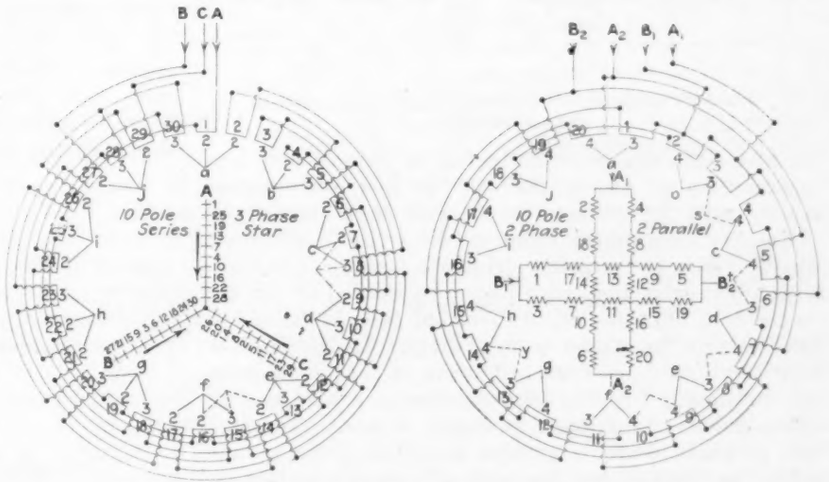
ODD grouping of coils added a difficulty to rewinding a 15-hp. induction motor recently sent to a New York shop. As the motor had seventy-two slots and was to be wound with ten poles this unequal grouping of coils was necessary. The original winding was for 440 volts, three-phase, 720 r.p.m., ten poles, 60 cycles, and the change was to 220 volts, two-phase, 720 r.p.m., ten poles, 60 cycles. The three-phase winding was connected series-star with seventy-two coils of seven turns of two No. 13 double-cotton-covered wires in parallel, wound in two layers with a coil pitch of 1 and 6. The odd grouping of this winding, shown at *A*, is perfectly balanced.

In calculating the two-phase winding it was first estimated that with the original three-phase, 440-volt winding, connected series-star, the voltage on each phase is 440/1.73, or 254.3 volts. The total winding, therefore, was good for $3 \times 254.3 = 763$ volts. In a two-phase winding this winding would develop 381.5 volts, but as 220 volts was required, rewinding was necessary. If the number of turns were reduced to give 220 volts, the copper cross-section would be enlarged and a stiff coil difficult to handle would result. Therefore, it was decided to use a two-parallel connection, increasing the number of turns per slot and using a smaller wire. The turns per coil for this winding were found to be $7 \times [(220 \times 2) \div 381.5]$, or eight turns. The size of wire was seven-eighth times the area of two No. 13 wires, or $\frac{7}{8} \times 5{,}178 \times 2 = 8{,}803$ circ.mils. To make a flexible coil two No. 14 wires with a cross-section of 8,212 circ.mils for both were used; therefore, seventy-two coils were wound of eight turns of two No. 14 double-cotton-covered wires in parallel.

Since there were ten poles and seventy-two slots, an odd grouping was necessary. The number of coils per phase was $72 \div 2$, or 36, and as there were ten poles, there were $36 \div 10$, or 3.6 coils per phase per pole. This means there are some three-coil groups and some four-coil groups. Dividing 36 by 10 gives as a result 3 and a remainder of 6. Then for each phase there are six groups which have four coils and the rest of the groups (10 — 6, or four groups) have three coils. The sum $(6 \times 4) + (4 \times 3)$ equals 36.

In order to place the groups symmetrically, for each six four-coil groups there are four three-coil groups, or three four-coil for two three-coil. Therefore, with five groups, a symmetrical arrangement is 4–3–4–3–4. This forms one-fourth of the total winding. By repeating this sequence as in *B* the whole winding is made symmetrical for a two-phase machine.

In checking a winding containing odd coil groupings diammetrical phase groups should contain the same number of coils and diametrical polar groups should contain the same number of coils. Referring to *B*, the figures in the small circles indicate the number of coils in series in each group. The groups are also numbered from 1 to 20. When it is said that diametrical groups must be equal it is meant that group 1 and group 11, for instance, must have the same number of coils, which in this case is three. Other diametrical groups are 2 and 12, 6 and 16.



CONNECTIONS FOR ODD COIL GROUPINGS ON INDUCTION MOTOR

At left, 440-volt, three-phase motor had seventy-two coils and slots, thirty groups, six groups of two coils and four groups of three coils in series per phase. At right, reconnected for 220 volts, two-phase, has twenty groups, six groups of four coils and four groups of three coils in series per phase.

Regarding the other condition, polar groups are any two adjacent groups for a two-pole machine, as 2 and 3, forming group *b*. The diametrical pole *g* is exactly opposite, or ten groups away, and the sum of coils in *b* $(4 + 3)$, must equal the sum of coils in *g*, $(4 + 3)$. At the next instant the pole has shifted from *b* to *s*, which must be checked against *y*. With a three-phase machine the pole would slip even one more group.

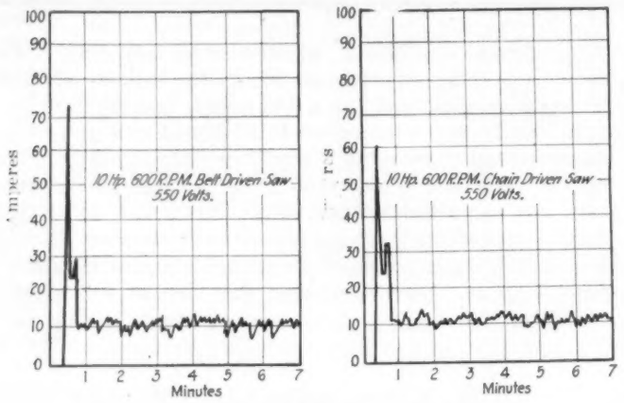
C. A. JOHNSON.

Bronx, N. Y.

Motor Drive Takes Less Power for Starting with Chain than with Belt

FROM recent tests in a Canadian shop it was found that starting a 10-hp. motor driving a saw by a chain takes only 84 per cent of the power required for a belt drive. About 74 amp. was required, as will be seen from the accompanying chart, to start the motor with the belt drive—whereas starting with the chain

drive required only about 62 amp. The reason for this is that the belt must be made tight in order to perform its function, while the chain can be run loose. This tight belt causes friction on the bearings and makes starting difficult. With the chain drive, on the other hand, there is a certain amount of slack which allows the motor to start immediately when power is thrown on it, even before the saw starts. With this initial start



COMPARISON OF POWER REQUIRED BY BELT AND CHAIN DRIVES

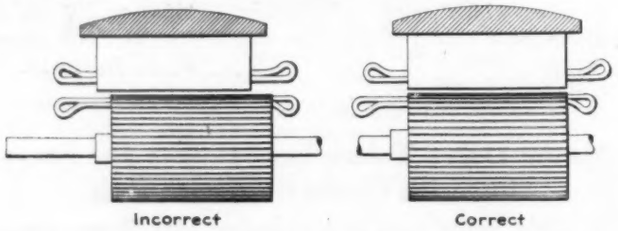
the motor can overcome the inertia of the saw with less consumption of power than if the saw was started exactly with the motor as in the case of the belt drive.

Another case which came to the writer's attention was that of a 15-hp. motor driving a planer. Formerly with a belt drive the motor had to be started by pulling on the belt, but since chain drive has been installed the motor starts the planer without help. Another advantage of chain drive over belt drive is that a chain is not continually running off the pulley as a belt may do unless guides are arranged to keep it in place. The first cost of chain drive is greater than belt drive, either rubber or leather, but the cost of renewals is less on the chain drive and the life is five times that of a belt.

Port Arthur Pulp & Paper Co. H. E. STAFFORD,
Port Arthur, Ont. Electrical Engineer.

Bearing Trouble Results from Uncentered Rotor

OVERHEATING of one bearing of a motor in an Eastern industrial plant was found after some investigation to be caused by an incorrect position of the rotor on the shaft. When this motor operated it was found that one of the bearings became too hot for safety after a few minutes of running. As the motor



UNCENTERED POSITION OF ROTOR CAUSED BEARING TO HEAT

had recently been fitted with a new shaft, it was thought that the rotor had not been centered properly with regard to the stator. The first investigation was made by comparing the relative position of the ends of the stator and rotor coils on each side of the motor. These coils appeared to be in the same relative position on both sides, but a more careful investigation revealed the fact that the coils extended further from the rotor laminations on one end of the motor than they did on the other end. Therefore the motor was investigated to see if the laminations of the rotor were centered with regard to the laminations of the stator. It was found that the rotor had been placed on the shaft a little out of the center with regard to the stator laminations. This was responsible for the pulling of the motor toward one of the bearings and the consequent abnormal friction on the thrust collar which caused the overheating.

When the rotor was shifted so that the laminations checked with those of the stator, the motor operated perfectly and no more bearing trouble was experienced.

New York, N. Y. W. A. HARRIS.

Generator and Switchboard Arrangement to Give 220 Volts to 2,300 Volts

TO OBTAIN any voltage from 220 volts to 2,300 volts for testing motors, etc., in the shop of McCleary, Wallin & Crouse, Amsterdam, N. Y., the leads from pole groups of a 2,300-volt generator have been brought out and connected to the switchboard shown in the accompanying illustration. This twelve-

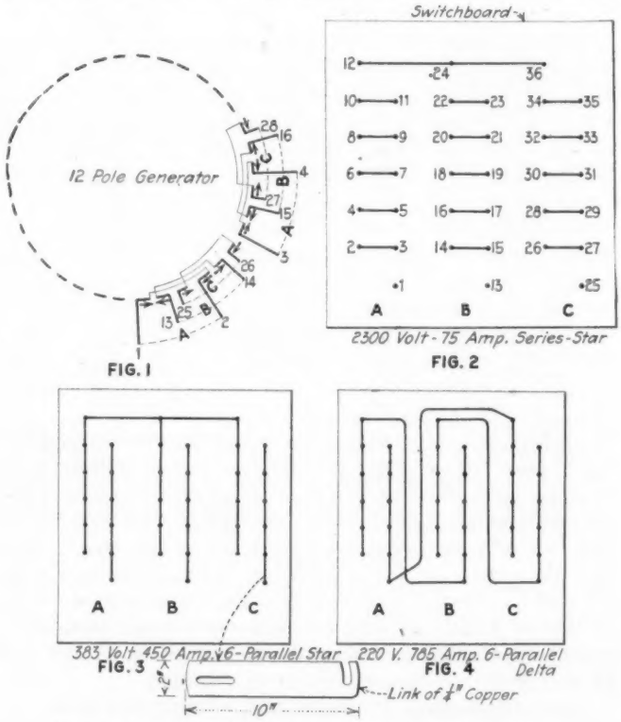


FIG. 1 FIG. 2 FIG. 3 FIG. 4

BY CHANGING LINKS ON BOARD FROM 220 VOLTS TO 2,300 VOLTS IS OBTAINABLE

pole, three-phase generator is installed about 6 ft. (1.8 m.) from the switchboard, and No. 2 flexible leads are brought out as shown in the diagram and connected to ⅞-in. (2.2-cm.) round brass studs in the board. About ¾ in. (2 cm.) of stud protruding from the front side of the board is threaded to take a wing nut with a 1½-in. (4-cm.) face. The connecting links are made of ¼-in. x 2-in. x 10-in. (6-mm. x 5-cm. x 25-cm.) strips of copper, slotted in each end as shown. Copper washers are used for separating the links. The board is made of 2-in. (5-cm.) marble, 3 ft. (1 m.) wide and

VOLTAGES AND CURRENTS OBTAINED FROM TEST SWITCHBOARD

Volts	Amp.	Connection
2,300	75	Star
1,917	75	Star
1,533	75	Star
1,328	130	Delta
1,150	150	Star
1,107	130	Delta
885	130	Delta
767	225	Star
664	260	Delta
442	390	Delta
383	450	Star
221	780	Delta

3½ ft. (1.2 m.) high, and is mounted on 1¼-in. (3-cm.) iron pipes. By changing the links on the board any voltage from 220 to 2,300, three-phase or single-phase, may be obtained with the corresponding currents shown in the accompanying table. It will be noted that for some values of voltage the full rated power of the generator cannot be obtained. By varying the speed of the prime mover this generator may also be used for 40 cycles and 25 cycles with corresponding change in voltages.

A. R. McDONALD.

Amsterdam, N. Y.

Two 500-Hp. Alternating-Current Motors Divide Hoist Load Equally

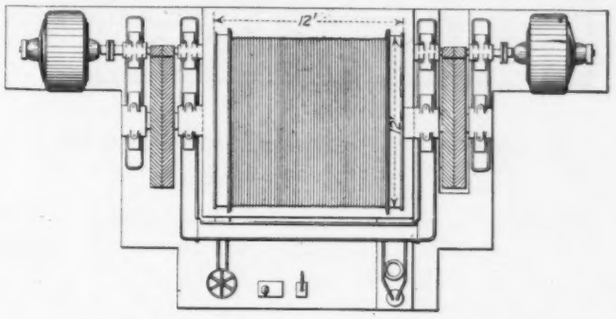
TWO 500-hp. slip-ring-type motors operated by a special controller drive a 1,000-hp. mine hoist with a rope speed of 1,450 ft. per minute (7.4 m. per second) in the plant of the Cleveland Cliffs Iron Company, Ishpeming, Mich. The motors are 2,200-volt, three-phase, 60-cycle, 450-r.p.m. (synchronous) General Electric slip-ring type with a full-load temperature rise of 40 deg. C.

The control was of special construction, as it was necessary to insure an even division of the load between the two motors. The primary windings of the two motors are connected in parallel to six-pole, reversing, air-break, solenoid-operated contactors. The secondary winding of each motor is connected to individual six-point, three-phase, solenoid-operated contactors with separate resistors for each motor. With this arrangement the motors can be made to divide the load to any desired proportion by properly adjusting the secondary resistances.

The control circuit is 440 volts alternating current and is carried through a standard ten-point reversing drum controller, with the control wiring of the secondary contactors connected in multiple. The control apparatus is equipped with the usual current-limiting relays, low-voltage contactors, emergency switches and an extra interrupting contactor to insure absolute electrical interlock and to prevent short circuit.

The hoist drum is 12 ft. in diameter by 12 ft. face (3.6 m. x 3.6 m.), and the installation of two motors instead of one gave a well-balanced mechanical condition, as may be seen in the illustration. The hoist is designed to operate from a maximum depth of 3,000 ft. (915 m.) with a rope speed of 1,450 ft. per minute (7.4 m. per second). Balanced skips are employed, each of which weighs 10,000 lb. (4,500 kg.) and will carry 12,000 lb. (5,500 kg.) of ore. Such an installation might be thought to require direct-current equipment, because 400 hp. or 500 hp. is generally considered about the maximum for alternating-current mine hoists. However, direct-current equipment, including the necessary motor generator set, is very expensive, and all objections to the alternating-current equipment were overcome by dividing the load between the two 500 hp. motors geared to the same hoist.

As a preliminary test, after the installation had been completed, the hoist was operated at full speed forward,



BALANCED MECHANICAL CONDITIONS SECURED BY USE OF TWO MOTORS TO DRIVE HOIST

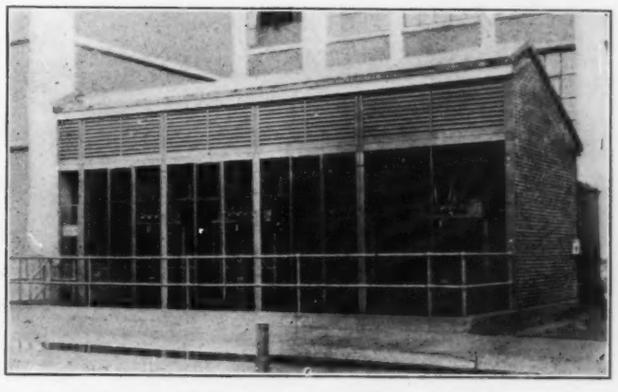
and then the controller was quickly thrown to full speed reverse. The apparatus functioned perfectly, bringing the motors to full speed reverse without distress. There was also a perfect division of the load between the two motors at all loads and speeds.

F. C. STANFORD,
Chief Electrical Engineer.

Cleveland Cliffs Iron Company,
Ishpeming, Mich.

Operating Indoor Transformers Partly Exposed to Weather

SUBSTITUTION of copper straps for the knife-blade switches in the leads was practically the only modification necessary to operate the indoor transformers shown here in the partly open building used as a substation by the Naumkeag Steam Cotton Company, Salem, Mass. It was found that expansion and contraction of the blades and jaws of the knife switches on account of temperature changes loosened the contacts and caused heating. For this reason strap copper securely bolted was substituted for the knife switches. After this change no trouble was encountered from heating. This substation, which is built of two brick walls and a roof, saved the expense of changing over the transformers from the indoor to the outdoor type. Moreover, the free circulation of air around the transformers tends to keep them cool under heavy loads.



INDOOR TRANSFORMERS OPERATED IN PARTLY EXPOSED LOCATION

Boston, Mass. H. S. KNOWLES.

Central Station Service

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

Schedule of Forwarding Dates for District Office Reports

IN ORDER to have district office monthly reports forwarded promptly, the general office of the Pacific Power & Light Company at Portland, Ore., has adopted the accompanying schedule, which shows the dates on which the April reports were due and the dates the various reports were received from each district office up to May 15.

The blanks indicate that no report was required from

Report Form Number	1001	1105	19	55	90	C.C.	94	93	1103	1104	M.L.	1053	1019	1065
Due Date	29	1	2	2	2	3	4	10	10	10	10	12	12	12
District Offices:														
Walla Walla	3	29	1	3	3	0	5	5	30	30-	6	4	29	3
Pendleton	1	8	6	3	.....	0	8	8	8	8	0	8	8	8
Lewiston	3	0	3	3	.....	.....	4	4	.....	4	0	.....	4	4
The Dalles	28	5	6	3	.....	.....	4	6	3	.....	12	10	3	10
Yakima	3	0	3	3	3	3	3	10	3	3	4	7	5	5
Pasco	30	10	5	3	3	0	4	10	10	.....	0	10	10	10
Kennewick	.....	.....	4	4	4	0	4	10	10	.....	0	10	10	10
Sunnyside	30	3	3	3	3	.....	5	10	5	.....	7	5	3	7
Astoria	29	0	3	3	.....	0	8	6	6	6	0	6	7	6
Seaside	28	3	29	3	.....	.....	7	30	14	.....	0	30	5	30
White Salmon	28	3	29	3	3	.....	3	5	3	.....	0	30	29	29
Pomeroy	29	8	29	3	3	.....	.....	7	5	.....	12	7	7	5
Prosser	29	7	6	6	6	0	6	7	7	.....	0	10	7	6
Goldendale	29	8	5	3	3	.....	7	7	7	.....	0	7	8	0
Dayton	30	30	1	3	3	.....	5	7	30	.....	5	1	30	8
Waitsburg	29	3	3	3	3	.....	3	8	5	.....	5	5	3	5
Toppenish	30	14	5	6	6	.....	6	13	14	.....	11	0	0	14
Vancouver	28	3	4	30	30	.....	30	30	.....	1	0	.....	30	4
Hood River	29	7	3	3	.....	.....	3	6	6	.....	0	10	14	10
Power Department	.....	.....	.....	3	3	4	6	3	.....	.....	10	.....	6	.....
Kennewick Stores	1	1	.....	3	3	.....	.....	.....	.....	.....	0	.....	.....	.....
Const. Dept.	3	.....	.....	3	3	.....	3	.....	.....	.....	11	.....	.....	.....

the district office, and an "O" indicates that no report had been received in the general office on May 15. District office names are given in the order they are carried in the general office books and have no reference to the standing of the particular offices with respect to forwarding the reports promptly.

This record was published in the Pacific Power & Light Company's *Bulletin* and will be given from month to month as a means of speeding up the district offices.

Public Benefits from Rate Embodying Coal and Oil Clauses

FUEL oil introduced into a part of the boiler plant of the Narragansett Electric Lighting Company, Providence, R. I., is making possible a stabilizing of rates which would be difficult to obtain if coal alone were burned. A new fuel clause has been filed with the Rhode Island commission, and officers of the company state that the practical effect of the clause will be the maintenance of present rates in the face of steadily rising coal costs. Six of the twenty-four boilers now operated by the company are being equipped for oil burning or have been equipped in part.

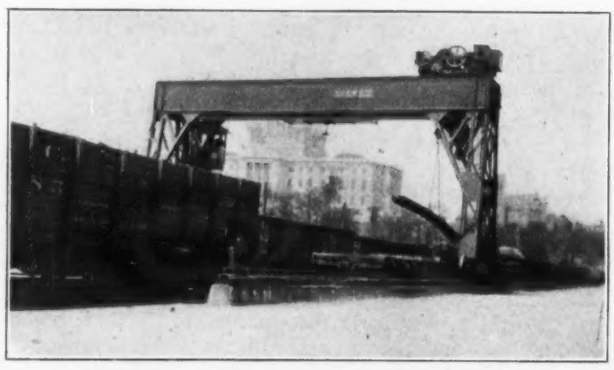
The new fuel clause as applied to power customers and to lighting customers under the company's schedules D, F, G and C has a rate based on a cost to the company of $8 for a gross ton of coal of 14,500 B.t.u. or an equivalent quantity of fuel oil measured in B.t.u. in the bunkers or oil service tank at the generating station. Such cost of fuel for any month is determined by dividing the total cost of all fuel burned by the number of tons consumed, this cost being obtained as follows:

By taking the weighted average cost per gross ton of all fuel in storage on the first day of the month and all fuel received during the month and multiplying such cost by the number of tons of fuel burned and adding thereto all handling, storage and carrying charges on fuel for the month. Storage and carrying charges on fuel include each month in addition to all other charges such sums as will compensate for any increase or decrease in the thermal value of the coal above or below 14,500 B.t.u. and provide for the amortization of approximately 75 per cent of the cost of all oil-burning, conveying and storage apparatus by July 1, 1922. A gross ton of fuel oil is considered to contain 32,480,000 B.t.u. The cost of fuel for any period longer than one month is taken as the weighted average of the foregoing monthly costs.

The new rate clause provides that for every 10-cent decrease or increase in the cost of fuel as above determined below or above $8 per gross ton there shall be a decrease or increase of 0.1 mill for each kilowatt-hour sold under the rate. Such adjustment is made for periods of three months each, using the cost of fuel as determined in the preceding three months' period for the quarter in question.

Lighting rates under the company's schedules A and B are similarly based, but unless the cost of fuel increases or decreases by $2.50 or more above or below the eight-dollar line no adjustment is to be made. If such a decrease or increase occurs in the cost of fuel, the decrease or increase established becomes 5 mills per kilowatt-hour sold under the rate. The adjustment periods in such case are six months each. Unless protest is made or the commission orders otherwise, the new clauses will go into effect July 1. It is possible that if the use of fuel oil increases largely in the plant, the average cost of fuel will be lowered sufficiently to permit rate reductions later.

One Way to Provide More Freight Cars for the Country



A 40-ton electric crane at Providence, R. I., unloads a car in two hours against two days by old hand-hoist methods.

Central Station Places Its Credit at Disposal of Dealers

AT A TIME when banks and investment companies are raising interest rates and telling electrical contractor-dealers to cut down on their time-payment paper, the Commonwealth Edison Company of Chicago has agreed to discount the time-payment contracts of any electrical contractor-dealer in Chicago at a cost of only 4 per cent for six months and 6 per cent for twelve months. It is just possible that credit may get so tight that the utility may have to withdraw this offer temporarily, but except in such a contingency it is the intention of the company to give the plan an extensive trial. During the summer months the central station is stimulating business by advertising that the people of Chicago can go into any electrical retail store in the city and buy such devices as flatirons, toasters and pot-type percolators and grills for $1 down. The balance is usually divided over a six-month period, but the contractor-dealer gets his money immediately from the Commonwealth Edison Company, which also collects all the deferred payments. During the summer campaign last year the company and 117 dealers sold 10,326 flatirons, 271 toasters and 414 percolators in less than three months. From present indications this year's results will be even more gratifying. Attractive window displays play an important part in the campaign, the Commonwealth Edison Company supplying posters and frames upon which to mount them.

ADVERTISEMENT OF SUMMER SALE

The dealer profits greatly by this co-operative summer campaign, but the central station is also benefited from a public-policy standpoint and by the sale of additional energy. The bookkeeping and collecting expense is very small, as the installments are added to the customers' lighting bills and no trouble whatsoever has been experienced on more than 99 per cent of the accounts handled.

Method of Posting Current Prices of Motors

FOR the convenience of employees, contractors, prospective customers and others, the power sales department of the Worcester (Mass.) Electric Light Company posts current prices of motors with auxiliary equipment on a 30-in. x 43-in. (78-cm. x 110-cm.) blackboard mounted in the department and illustrated herewith. This company has standardized on maximum-rated motors, and the prices in dollars shown in the three columns at the left apply to these motors only. At the right, listed as "specials," are a number of 40-deg. motors which the company had in stock. The prices of motors up to and including 2-hp. include a standard make of starting switch and from 3-hp. to 5-hp. overload protection equipment. With 7.5 hp. motors the company uses overload and undervoltage-release type oil switches,

MOTORS

STANDARD MAXIMUM RATED 3 Phase 550 Volt			NET RETAIL PRICES R. P. M.				SPECIALS		
	1800	1200	900				1800	1200	900
H.P.									
½							$69		
¾	$73								
1	78	$85					77		
1½	86								
2	94								
3	116	131							
5	131	151					139	$174	
7½	167	202					226	262	
10	235	275							
15	275	305						340	
20		347							
25		425						470	
30		475	$520						$602
40			610						692
50			695						776
60			780						
75									1433

BLACKBOARD FOR LISTING MOTOR PRICES

and above 7.5-hp. rating the company requires the use of a starting compensator with relays. All this auxiliary apparatus is covered in the prices listed, which show the cost to the customer of the motor equipment delivered on his premises.

Worcester, Mass. H. D. STOKES, Power Engineer.

Handling Rural Business in Ohio

FARMERS are demanding service in all directions, and the central stations have not agreed upon any one well-defined plan of handling the business, according to statements made by D. O. Vaughn, manager of the Sidney (Ohio) Electric Company, in the course of an address delivered before the new-business co-operations committee of the Ohio Electric Light Association. A number of methods have been devised for obtaining this business on a profitable basis. The three plans most actively in use were, according to Mr. Vaughn, the following:

First is the wholesale plan, under which farmers organize themselves into some sort of an association, purchase energy from a central station and distribute it themselves. This plan has the advantage that it eliminates any worry on the part of the company and the whole association is listed as one customer. However, the farmers do not always get along well together, and instead of growing stronger these associations generally become a source of argument in the community between those who are connected to the system and those who are not. The company may also have difficulty in making the association understand why the company's wholesale meter reads so many more kilowatts every month than the sum total of all of the consumers' meters. Not realizing that there are losses on the system, an association may set very low minimum charges or none at all. Another disadvantage of this plan is that the association generally neglects its maintenance until the service becomes poor.

The second plan is the group plan, under which the farmers organize a temporary association to finance and build the necessary lines. When completed, the farmers' association contracts with the utility to furnish retail service over these lines and issues a bill of sale to the company for all of the lines for and in consideration of $1. Under this plan the utility furnishes the necessary meters only, which are installed on the consumer's premises. The central station accepts the lines as a gift and then becomes liable for their maintenance and upkeep. Under this group plan the Sidney (Ohio) Electric Company requires that each consumer sign an individual contract for service in addition to the contract made with the association. The principal difficulty in the group plan comes in getting the association properly organized and in getting a workable agreement between the company and all of the farmers in the community after the lines are in operation.

The third plan is to deal with only one or at most a few farmers at a time and to have them sign individual contracts. Each farmer finances the cost of the necessary extension, transformers, etc., by paying this amount as a bonus to the company to get the line built to his premises. The title and ownership of the line and equipment always remains with the company. The farmer pays the regular farm lighting rates for service. The Sidney Electric Company accepts contracts of this nature for periods of not more than ten years. The advantage of this plan is the ease with which the business is obtained directly from each individual farmer. The unavoidable delays and expense which are always attendant upon farmers' organizations of any nature can in this way be avoided. The disadvantage of the individual plan is that only a few customers are added at a time, but this objection is usually more than offset by there being fewer misunderstandings, less argument and a reduction in the amount of time and money expended in acquiring the business.

Cost of giving service to the farmers was interestingly analyzed by Mr. Vaughn as follows:

"Assuming that the company's specifications call for well-constructed lines of 30-ft. Northern cedar poles and not less than No. 6 copper wire, I think it is fair to assume that this line may be said to last for from fifteen to twenty years, although this might vary in different localities, owing to soil conditions, storm center, etc. However, we believe it would not be out of reason to charge 5 per cent of the original cost of the line annually against the cost of giving this service for keeping up the lines. If the company owns the lines, it must also add taxes and insurance against liability, etc., which will be very close to 2 per cent per annum. This will necessitate a 7 per cent fixed charge against the cost of giving this service, or $70 per year per $1,000 worth of line. If the energy is sold to the farmer metered on his premises, there will also be the following service cost to each farmer:

Assuming a 2 kw.-hr. transformer, which has 23 kw.-hr. core loss per month at 3 cents per kilowatt-hour delivered	$0.69
Meter reading and billing per customer	0.10
Service to customer, such as driving out and fusing up transformers after a storm, etc., per customer per month	0.50
Total cost per month, not considering the energy used by the farmer	$1.29

"The average farmer is a much better user of appliances than the average consumers in the small town, and from our records, taken over a period of a year, of twenty-five farmers connected, we find that they average about 350 kw.-hr. per year use of energy or 30 kw.-hr. per month, this costing 3 cents per kilowatt-hour or 90 cents. If we have a $1,000 line, one mile long, carrying four farmers, they should then pay for the following total:

Maintenance charges per year	$ 70.00
Service charges per year, $1.29 × 12 = $15.48 × four customers	61.92
Four farmers at 360 kw.-hr. per year equals 1,440 kw.-hr. used, at 3 cents per kilowatt-hour	43.20
Total cost of giving the above service to four farmers	$175.00

"This comes to $43.78 per year, or $3.66 per month, per farmer, which is the actual cost of serving each customer."

A rate which would protect the company on this basis would be as follows:

A fixed charge of $1 per kilowatt of transformer capacity connected (but not less than $2) plus the regular lighting rates for energy, say, 10 cents per kilowatt-hour. If the above customers have 2-kw. transformers and use 30 metered kw.-hr. apiece, their monthly bills would each contain a fixed charge of $2 plus 30 kw.-hr. at 10 cents, $3, or a total of $5.

This would leave a profit of $1.34 per month, but had each customer used only 10 kw.-hr., there would have been a loss of 66 cents. It therefore behooves the central station either to insist upon at least four customers per mile of line, estimated to cost $1,000, or raise the fixed charge per customer to a point where it will be protected against loss by reason of lack of use of service.

Furthermore, if a profit is to be made from this business, it is very necessary to educate customers to use motors, pumps, heating appliances, ranges and all the large energy consuming devices possible in order to increase the kilowatt-hours used per month by each farmer.

"Commercializing" a Terminal House

FACING a main highway leading into Worcester, Mass., is a terminal house of the New England Power Company used in tying two 13,200-volt feeders run overhead from the Greendale substation to two underground lines feeding the American Steel & Wire Company and interconnected with the Worcester Electric Light Company. The power company has effectively used the terminal house wall to advertise its service, as illustrated.

Digest of Electrical Literature

Including Brief Abstracts of and References to Important Articles Appearing in the Scientific and Engineering Press of the World

Motors, Generators and Transformers

Sixty-Cycle Converting Apparatus.—J. L. BURNHAM.—It is said that synchronous converters for voltage of 500 and 600 have been freed from flashing through the use of high-reluctance commutating poles, a special form of brush rigging, screened flash barriers and the high-speed circuit breaker. The author makes a comparison between the synchronous converter and the motor-generator set on the bases of efficiency, reliability, flexibility, costs and floor space. He states that 2½ kw. of synchronous converters are built for every 1 kw. of motor-generator sets.—*General Electric Review*, May, 1920.

Dimensions of Single-Phase Traction Motors.—F. UNGER.—The output of an electric motor may be expressed in terms of the product of armature length, the square of the diameter and the number of revolutions per minute multiplied with a factor of utilization for the material which in correct design tends to a maximum value, depending on the permissible maximum induction and current density. On the basis of a careful study of the conditions affecting the utilization factor the author presents a number of diagrams and tables indicating what magnetic and electric densities should be allowed and what values of the utilization factor should be expected in ordinary cases.—*Elektrotechnische Zeitschrift*, Jan. 1, 1920.

Lamps and Lighting

A New Cadmium-Vapor Lamp.—FREDERICK BATES.—A new method for producing a cadmium vapor arc of great brilliancy has been discovered. It was found that the metal gallium would form an alloy with cadmium. Since gallium has a boiling point about 1,500 deg. C., the vapor pressure relation which exists between cadmium and mercury is reversed when compared with cadmium and gallium. The cadmium therefore acts as the energy carrier when used in combination with gallium in a quartz lamp.—*Scientific Paper No. 371, U. S. Bureau of Standards*, April 10, 1920.

Industrial Lighting as an Element in Mass Production.—LEON GASTER.—The writer discusses the results obtained in America by the use of higher intensity of illumination in industrial plants and points out the needs of British industries with particular regard to health of employees, safety and efficiency.—London *Electrician*, April 30, 1920.

Generation, Transmission and Distribution

Economical Aspects of Electrification in Belgium.—CARLIER.—A detailed comparison is made between the total cost of transporting the necessary coal for industrial purposes from the mines to the various industrial plants and the coal transportation costs if a total electrification were carried out, three steam-driven super-power stations being assumed to deliver all energy needed. The direct saving in coal transportation cost is estimated at 6,600,000 francs, and since the estimated investment for the electric super-power station system is about 60,000,000 francs, a decided economy would result from an electrification.—*Revue Générale d'Electricité*, March 6; *Bulletin de la Société Belge des Électriciens*, October-December, 1919.

Coal Conservation in the United Kingdom.—DUGALD CLERK.—In discussing the proposition of super-power stations for England the writer feels that it is necessary to take a broader view than has been done by the government committees. Not only should the efficiency for motive power be considered, but the whole heating systems of the country should be dealt with in order to obtain a combined efficiency of heating, lighting and motive power. To this end it is necessary to study not only the distribution of heat, light and power by gas and electricity but also the other methods of generating and distributing heat for domestic and manufacturing purposes. He discusses in considerable detail the claims which have been made for the super-power stations with respect to the possible saving of coal.—London *Engineer*, April 23, 1920.

Overloads on Telephone Conductors Due to Rain and Rime.—F. LOPPÉ.—The author reviews an article by Pillonel, in the *Revue Polytechnique* of Geneva, in which a great number of interesting cases of overloads on telephone and telegraph conductors along the lines in the Alps are reported. Overload factors as high as twelve, and even twenty-four, have been observed during severe rime formation. According to direct measurements at a station on St. Bernard, the extra load on ordinary sizes of telegraph wire varies from 80 grams to 150 grams per meter wire during rain, while the overloading due to rime may reach values as high as 2,000 grams per meter.—*L'Industrie Electrique*, Jan. 25, 1920.

Switching and Protection of Transmission Circuits.—S. Q. HAYES.—The author discusses some of the principal features of switching and protection of power transmission systems, dealing principally with oil circuit breakers, relay equipment, lightning arresters, station layouts and system arrangement. A few high-voltage transformers used on some of the larger systems are described, and attention is called to their important features. The discussion is practically limited to plants furnishing energy at 22 kv. and above. *Electric Journal*, May, 1920.

Half-Wave Transmission Lines.—BRYLINSKI.—Taking one step further from the quarter-wave transmission line suggested by Bunet, the author inquires as to the feasibility of operating lines of one-half wave length. Such a line offers the advantage of rather good voltage regulation and thus could be used with ordinary alternators. In the middle of the line very high voltages may occur, which, however, may be taken care of by

providing special insulators over a certain range. A half-wave line at 50 cycles is about 3,000 km. (1,870 miles) long, but a geographically shorter line may be made into a half-wave line by inserting a few loading coils or by inserting lengths of high-tension cable at certain points. The voltage rise is greater on an inductively loaded line for given received current. This limits the amount of power possible to transmit over the half-wave line. A three-phase line of aluminum conductors with 5 sq.cm. (0.776 sq.in) sectional area thus could transmit not more than 20,000 kva. at 70,000-volt star pressure at receiving station, if inductance loaded, as against 80,000 kva. under same conditions if loaded with capacity.—*Comptes Rendus*, April 19, 1920; *Revue Générale d'Electricité*, May 8, 1920.

Relative Merits of Connections Employed in High-Voltage Generating Stations. — ERNEST PRAGST. — In planning a system of connections for a central station consideration must be given to the following factors: (1) It should not afford an undue risk to the operating force; (2) it should permit of the economic operation of apparatus; (3) it should be simple in principle electrically; (4) it should lend itself to simple and rugged mechanical arrangement and construction; (5) it should have a reasonable degree of flexibility; (6) it should assure a degree of continuity of service commensurate with the class of load served. The author presents and discusses eight different systems of station connections.—*General Electric Review*, May, 1920.

Electrical Characteristics of Transmission Circuits.—WILLIAM NESBIT.—A brief review of hyperbolic trigonometry is given before taking up the application of hyperbolic methods of calculating transmission lines. The work of Dr. A. E. Kennelly, F. E. Pernot and Edy Velander are referred to in the development of the method.—*Electric Journal*, June, 1920.

Traction

Motor Buses or Trackless Trolleys.—H. L. ANDREWS. —The trackless trolley, although practically unknown in this country, is said to be making a good record for earnings and service abroad. A comparison of its operating cost with that of the motor bus and the most modern street-railway practice shows that on an equal service basis and equal fare the motor bus cannot compete with the street car but that the trackless trolley can. A true comparison of the relative operating costs of the gasoline motor bus, the trackless trolley and the safety car, assuming that the gasoline bus can be operated with one man, is given in the following table:

	Cents per Bus Mile		Cents Per Car Mile
	Gasoline Bus	Trackless Trolley	Safety Car
Maintenance of overhead		0.5	0.5
Maintenance of way			1.5
Road taxes	0.75	0.75	
Maintenance of equipment	8.54	3.0	2.0
Platform expenses	8.0	8.0	8.0
Traffic expenses	0.04	0.04	0.04
Power	4.54	1.8	1.8
General	3.54	3.54	3.54
Depreciation	6.59	2.0	2.0
Total	32.00	19.63	19.38

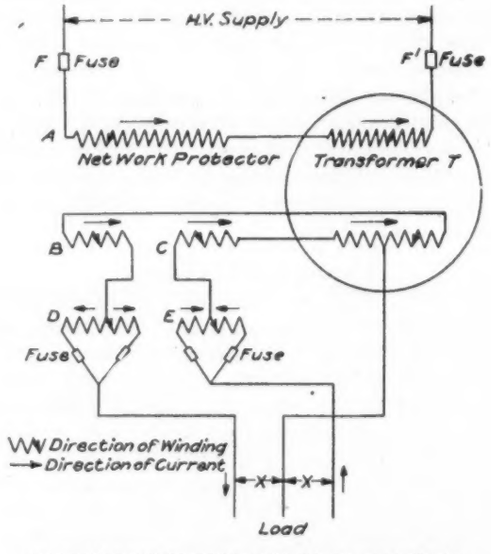
On account of the fact that the proposed equipment of the trackless vehicle and the power distribution to it are essentially the same as those of the street car, it is said to be suitable as an auxiliary to a street-car system, and the author recommends that the railway operators adopt it either as an auxiliary or to eliminate competition.—*General Electric Review*, April, 1920.

Installations, Systems and Appliances

A New Type of Arc-Welding Generator.—S. R. BERGMAN.—Where each welder is furnished with an individual generator the necessary regulation is said to be best effected through special inherent regulation in the generator itself. A machine which has been developed to embody the characteristic of constant-energy output is described in this article.—*General Electric Review*, May, 1920.

Industrial Electric Heating.—WIRT S. SCOTT.—Dealing particularly with temperatures under 600 deg. Fahr. (315 deg. C.), the author states that the question no longer is what electric heating costs but rather what are the advantages of this method. He gives some experiences in the automobile industry where the method has been highly successful because of the small amount of spoilage. The uniformity of temperature and automatic temperature control are said to be large factors in the test of electric heating; moreover, the cost of labor is reduced.—*Electric Journal*, May, 1920.

The Alternating-Current Network Protector.—H. C. STEWART.—A factor which has prevented the general adoption of alternating-current networks is the fact that there is a chance that an internal failure in



ALTERNATING-CURRENT NETWORK PROTECTOR

one transformer may impose an overload besides the short-circuit current on the adjacent transformer, thereby blowing the primary fuse. This action will progress from transformer to transformer until the entire system is disconnected. The alternating-current network protector has been developed to overcome this difficulty. It has been in use for a number of years on large network systems in New York City. The protector is a transformer device with three sets of windings, as shown in the diagram. Normally, when the current flows from the high-voltage supply, the current in the transformer and three protector windings are as shown. The protector windings are mounted on a separate core in such a way that the core is not magnetized under normal conditions. In case of a fault in the transformer *T*, however, currents in the secondary circuit are reversed. The protector core is magnetized

and heavy currents flow in the windings *D* and *E*, so that the secondary fuses blow at practically the same time as the primary fuses *FF'*, completely disconnecting the transformer from the network.—*General Electric Review*, May, 1920.

Electrophysics and Magnetism

Some Notes on Vacuum Tubes.—JOHN H. MORECROFT.—The value of the exponent connecting plate current and plate and grid potentials is experimentally investigated for a number of tubes. It is found to be markedly different for different tubes and for the same tube at different plate voltages. Particularly is this the case for low-plate voltage tubes. After discussing briefly distortion in amplifying tubes, the capacity and conductance within tubes is considered. Experimentally determined data governing these quantities are given, these being obtained on a carefully designed radio-frequency Wheatstone bridge. An experiment on the detecting action of a tube without grid condenser seems to prove that grid-to-filament circuit asymmetry of characteristic is not responsible for the detecting action.—*Proceedings Institute of Radio Engineers*, June, 1920.

Radio-Frequency Inductance Coils.—M. K. ZINN.—A discussion of some of the practical considerations which enter into the design of inductance coils for radio frequencies with particular reference to their application in circuits intended for the reception of long undamped waves. The theoretical behavior of coils at high frequencies is reviewed, and for illustration impedance measurements on a typical antenna load coal are presented.—*Wireless Age*, May, 1920.

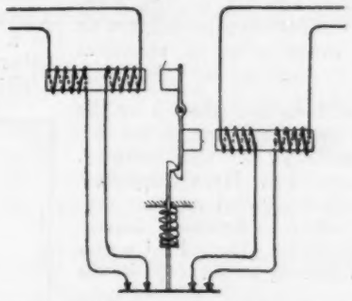
Units, Measurements and Instruments

A New Spectropyrheliometer and Measurements of the Component Radiations from the Sun and from a Quartz Mercury-Vapor Lamp.—W. W. COBLENTZ and H. KAHLER.—This device consists of a quartz spectograph and cylindrical condensing lens, placed upon an equatorial mounting. In this manner the ultra-violet absorption in heliostat mirrors is avoided. Data are given on the relative components in infra-red, visible and ultra-violet radiation from the sun and from a quartz mercury arc lamp; also data on the gas-filled tungsten lamp, the iron arc and the carbon arc. In two appendices methods are given for excluding ultra-violet light from buildings and for protecting projection lantern films from the heat of the lamp.—*Scientific Paper No. 378, Bureau of Standards*, April 9, 1920.

Telegraphy, Telephony and Signals

Radio-Frequency Alternators.—MARIUS LATOUR.—In this article, which is partly reproduced from a paper presented before the Société Française des Electriciens, the different types of alternators capable of practical application to the direct production of radio-frequency currents are described. The author pays particular attention to the French designs of alternators, which he describes as "homopolar alternators with partial utilization of the periphery" and "homopolar variable reluctance" alternators.—*Proceedings Institute of Radio Engineers*, June, 1920.

A Reversing Interrupter for Spark Coils.—FALKENTHAL.—A great part of the German portable radio sets used in the war were built for spark-coil excitation and provided with a special double-pole interrupter, or rather reversing contact, for converting the battery current into audio frequency spark impulses. The action of this device, called the "Falkenthal pendulum converter," may be seen from the figure where *cc'* is a polarized contact maker, sending the primary current alternatively through the windings *a* and *a'*, which are connected in opposition. For each full oscillation of the tongue the iron core thus will be carried through one full hysteresis cycle. This feature makes for a remarkably high efficiency (80 per cent of direct-current-



DOUBLE-ACTING SPARK-COIL INTERRUPTER

alternating-current conversion); *ded'* is an audio oscillating circuit, tuned to the tongue frequency, which prevents sparking at the contacts; *f* is a high-frequency choke coil, and to the right is indicated the radio transmitter with quenched spark-gap and antenna. The interrupter is claimed to give as good constancy of tone as an alternator and may be built to handle 250 watt primary energy.—*Jahrbuch der drahtlosen Tel. und Tel.*, October, 1919.

Characteristics of Static Frequency Doublers.—T. MINOHARA.—The author distinguishes between two fundamental modes of operating a static frequency doubler. In one system it is attempted to obtain a rather pure sinusoidal secondary current, and for this purpose a relatively low direct-current excitation is used in the frequency doubler. The output then is limited by the rule that the ratio of primary alternating current to the exciting direct current should not exceed 1.66. The other system is called the impulse system. Here the cores are almost saturated by the direct-current excitation and a very peaked secondary voltage results, the second harmonic being sifted out by use of resonant circuits. In the impulse-excited frequency doubler the primary input may be relatively greater than for the sinusoidal doubler. The iron losses per unit volume are considerably larger, but the total core volume per kilowatt may be greatly reduced. These observations follow an analytical treatment of the two systems, illustrated by a great number of curves and oscillograms.—*Revue Générale d'Electricité*, Feb. 28, 1920.

Miscellaneous

Predictions of Water Flow in Rivers.—AXEL WALLEN.—For many years the author has been working on a method of predicting water flow in rivers, and for this purpose he has made an extensive statistical analysis of water-stand data from about twenty-seven stations along Swedish watersheds. Several diagrams showing observed values and also giving such curves as were calculated beforehand indicate surprisingly small deviations and show that the author's pre-calculations give a very fair idea of the general shape of the water-stand curve. The author, however, points out certain failures, emphasizing the necessity of further refinements in the method.—*Teknisk Tidskrift, Veckoupplagan*, March 27, 1920.

News in Brief

Summary of Market Conditions and of Recent and Approaching Happenings of Importance to the Industry

OPTIMISM prevails in business circles, the excellent grain crop prospects on the Pacific Coast and a reported large increase of new industries in the South being among the contributing causes. There is some building activity, in New England and California especially, with resultant large sales of electrical material.

SALES of fans are affected by the degree of heat prevailing in the different sections of the country. Southern stocks are largely depleted, but comparatively cool weather prevents a heavy demand in Northeastern territory. Household appliances are moving well except in the East.

SHIPPING and receiving troubles continue to handicap business, and few price changes of importance are reported. Collections are only fair.

HYDRAULIC turbines are to be manufactured in Canada by agreement with the Cramps for exclusive use in the British Empire of their waterwheel and other hydraulic designs.

PRODUCERS of electrical material are divided on the question of raising schedule material lists as recommended by the Electrical Supply Jobbers' Association last year.

A GOOD demand exists for motor-driven chain blocks, which can usually be filled from stock. Considerable difficulty is being met in getting enough motors to supply requirements.

STEEL interests are still adversely affected by traffic and labor conditions. A shutdown in sheet and tinplate mills is threatened. The effect on the steel output to the electrical trade is naturally not favorable.

A REDUCTION of one-half the 10 per cent surcharge on retail lighting bills and a 10 per cent increase in salaries and wages of all employees of the Boston Edison company became effective July 1. Combined, these mean $600,000 per year.

SHUTDOWNS of many New England industrial plants are threatened by the curtailment of coal supply, aggravated by further "outlaw" strikes of switchmen at important railroad yards in the East.

A MOVEMENT to bring about closer co-operation among the New England States in water-power development is being discussed in legislative circles in Massachusetts, the coal shortage giving a sharper point than hitherto to arguments in favor of storage development and energy interchange.

TEN YEARS preceding 1920 were declared a fair period for utility valuation and cost averaging by the Vermont Public Service Commission in a decision sustaining the power rates of the Montpelier & Barre Light & Power Company.

A FIVE-MILLION-DOLLAR power plant on the Coosa River, near Gadsden, Ala., will, it is asserted, be under way before Aug. 1, as a result of the signing of the water-power bill. The Alabama Power Company is to build it.

AN ORDER from the Georgia Railroad Commission is being sought by the Atlanta City Council to compel the Georgia Railway & Power Company to make 200-ft. extensions of its wires free, as required by its franchise. Lack of funds is given by the president of the company as its reason for not doing so.

CLOSER attention to analyses of rainfall records in the operation of combined water-power and steam plants was urged at the Utica (N. Y.) convention of the Empire State Gas & Electric Association.

A COMPREHENSIVE program has been arranged for the meeting of the Ohio Electric Light Association at Cedar Point, Ohio, on July 13 to 15.

IT IS EXPECTED that the revised edition of the National Electrical Safety Code will be issued by the Bureau of Standards late in the summer.

WILLIAM S. MURRAY has been designated by the director of the Geological Survey as chairman of the engineering staff which will conduct the preliminary survey of the Boston-Washington super-power plan. The personnel of the engineering staff and of the advisory committee will be selected within the next few days.

ADDITIONAL applications for permits under the water-power act are being filed each day. President Wilson has designated the Secretary of War as chairman of the Federal Power Commission.

JUNE showed a total issue in bonds, stock and notes of electric public utilities of $22,903,000—the lowest monthly figure since February. This makes the total securities floated for the first six months of 1920 reach $172,501,440, of which $29,896,440 is in stock and $142,605,000 in notes and bonds.

MEETING at White Sulphur Springs, W. Va., the annual convention of the A. I. E. E. opened on Tuesday with more than 200 delegates in attendance. The technical and entertainment features of the program were carried through with success.

ASSERTING that the rates of the Puget Sound International Railway & Power Company are unreasonable, the Public Service Commission of Washington has ordered a reduction to a figure at which earnings will be 8 per cent on the total valuation.

APPLICATIONS to the California Water Commission for permission to extend hydro-electric resources include one from the city of Los Angeles, which asks for 1,400 second-feet from the San Joaquin River, and one from H. L. Jackman asking for 9,000 second-feet from the Klamath River.

A SOMEWHAT brighter outlook for coal supply is reported, though danger of a grave shortage is not over. The Interstate Commerce Commission and railroad executives are working to relieve the situation.

A STATEMENT dwelling on the brighter outlook for public utility securities that it feels to prevail has been issued by the National City Company of New York.

PROGRESS in standardization was achieved by the Associated Manufacturers of Electrical Supplies, in session at New London, Conn.

A LIBERAL policy toward agricultural users of electrical energy was advocated by the Iowa Section, N. E. L. A., convention held at Colfax.

SIX HUNDRED members and visitors of the A. I. and S. E. E. inspected the 50,000-hp. electrical installation of the Trumbull Steel Company at Warren, Ohio.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

Coal Situation Looking Brighter

ALREADY the result of the order of the Interstate Commerce Commission relative to Eastern shipments of coal in open-top cars is being felt. Where a week ago the situation looked very dark it is now more reassuring. The coal shortage, however, is still real.

Public utilities outside of New England are protesting against the Interstate Commerce Commission's order giving preference and priority to coal shipments to New England. Representatives of New York, New Jersey and Philadelphia utilities have been in consultation with railroad officials, who have assured them that every effort would be made to relieve the situation. Nothing can be done yet, however, to build up storage.

New York utilities have decided to stand together, and where one utility is short of coal the others that are more fortunate will lend it the required fuel.

Other Eastern utilities are feeling the pinch. The Potomac Electric Power Company of Washington, D. C., last week had a six days' reserve on hand and at that time was receiving much less than was required daily. Massachusetts utilities and those of New England generally are complaining of the shortage. Reports received by the Geological Survey from thirty-three out of thirty-four electric utilities in New England show an average weekly consumption during the year of 34,225 tons. On May 31 these utilities had 199,830 tons on hand, or enough for five weeks and six days.

The Michigan coal situation, while still acute, according to reports is gradually getting better.

Very high prices are being charged for coal in the open market. Many utilities find that their coal contracts expired this week, or July 1. Much higher prices in these cases must be paid for contract coal. The prices being charged for coal are receiving consideration by the Department of Justice.

Quotations of $10 and $11 on the Eastern seaboard for bituminous coal are quite common.

Six Hundred Engineers Inspect 50,000 Hp. Steel Mill Installation

THE great responsibility of electrical engineers in industry and the appreciation of their importance by the management of the companies concerned was manifested in a striking manner at the joint meeting of the Pittsburgh and Cleveland district sections of the Association of Iron and Steel Electrical Engineers last Saturday. Before noon about 600 members and visitors assembled at the works of the Trumbull Steel Company, Warren, Ohio, to inspect the company's 50,000-hp. electrical installation and to hear some of the salient features described in a paper presented that evening.

The engineers were guests of the Trumbull Steel Company from the time they arrived until the end.

W. M. McFate, vice-president of the Trumbull Steel Company, addressing the banqueters, expressed the gratification of the company at the interest displayed in its equipment and methods. A technical description of the company's strip-mill motor installation, with its Scherbius system of control, was given by A. W. Mohrman, electrical superintendent of the company.

Supply Manufacturers Meet to Further Standards

WORKING always toward a greater degree of standardization in the manufacture of electrical supplies, the various sections of the Associated Manufacturers of Electrical Supplies met individually at the Hotel Griswold at Eastern Point, New London, Conn., on June 28, 29 and 30. Considerable progress was made in the important session which the general standards committee held. Of special interest is the closer co-operation of the manufacturer of electrical supplies and the central station.

The only open meeting was on Monday evening, when Judge T. M. Debevoise spoke strongly on the benefits derived from the social as well as the business gatherings of the association, both of which fostered that spirit of co-operation so necessary to the organization. William Burgess outlined briefly the work of the International Trade Committee from its inception to the present time and indicated the extent to which German and Japanese electrical goods were being imported.

Secretary of War to Be Chairman of Water Power Commission

THE Secretary of War has been designated by the President as chairman of the Federal Power Commission. The actual selection of the executive secretary and the engineer officer of the commission will await the return of the Secretary of Agriculture to Washington. The Secretary of the Interior is en route to Alaska, but it is understood that no action with respect to the Water Power Commission will be delayed as a result.

Each day is seeing the filing of additional applications under the act. There will be a mass of work awaiting the executive secretary of the commission as soon as he is designated. The plans put forward by each of the applicants must be reviewed, to say nothing of preparing to start studies of various projects at the earliest possible moment. One of the first matters which must be taken up is the settlement of the Niagara situation. The authority to divert water expired with the passage of the act. Several important problems on the St. Lawrence River must have early consideration.

It has developed that Senator Jones gave Secretary Payne his written promise to do all in his power, as chairman of the committee on commerce, to obtain the repeal of that section of the act which allows the use of any lands within the boundaries of a national park

in connection with any water-power project. It develops that Senator Jones and Secretary Payne were in conference for the greater portion of a day discussing the provisions of the bill which had caused Secretary Payne to make an unfavorable report to the President. Secretary Payne withdrew his objection only when Senator Jones promised to exert himself in the manner mentioned. The probable effect of an amendment such as will be proposed by Senator Jones will be the adoption of new boundaries for national parks at points where it is desirable to utilize the area for power purposes.

Boston Edison Reduces Rates and Increases Wages

INCREASING revenue due to the growth of business has led the Edison Electric Illuminating Company of Boston voluntarily to announce a general 10 per cent raise in salaries and wages, effective July 1, and a reduction of half the 10 per cent surcharge lately imposed on retail customers' bills. Every employee in the company's service benefits by the wage advance, which will increase the expenses of the system by about $300,000 a year. Within the past two years the total salary increase has amounted in representative cases to more than 50 per cent. President C. L. Edgar informed a representative of the ELECTRICAL WORLD that the reduction of the surcharge to 5 per cent of the bill would also cost the company about $300,000 a year. The average increase per employee will be about $130 per year.

Only retail customers of the company will be affected by the reduction in surcharge, while the maximum rate remains at 10 cents per kilowatt-hour. The company's business is running about 25 per cent above last year's, and it is accumulating a surplus. In the last fiscal year the company supplied energy to 110,320 customers using lighting service, and its revenue from commercial lighting was $7,210,595, and its output sold for this purpose was 90,222,448 kw.-hr.

Analysis of Rainfall Records Emphasized at Empire State Meeting

CLOSER attention to analyses of rainfall records and to accurate checks on the available storage is of greatest importance to the efficient operation of a combined water-power and steam-power system. This was very forcefully brought out in the discussions of the subject at the meeting of the electric production and distribution sections of the Empire State Gas and Electric Association at Utica on June 23 and 24.

It was pointed out by R. C. Reynolds of the Empire Gas & Electric Company that the 40 per cent factor used in computing run-off is apt to be misleading. W. J. Fox, Fort Plain Gas, Light, Heat & Power Company, said that an analysis of rainfall records in that particular section of the state covering a period of forty years shows that there is a definite cycle of precipitation closing on itself every ten years. A graphic recording instrument to keep a continuous check on the elevation of the storage pond had been found by B. E. Phile of the Utica Gas & Electric Company to be very valuable.

Load dispatching was another subject that met with considerable discussion, E. P. Perk, Utica Gas & Electric Company, pointing out that the ideal load dispatcher should know his equipment, what its capabilities are during the particular operating conditions, transformers, lines, voltage drops, load-carrying efficiency of lines, substations, steam plants, distribution lines, water conditions, how much load to carry on each unit, in case of rain to be able to calculate in advance the use which will be made of the water and many such factors. That hydro-electric plant equipment will be subject to considerable development was shown by Mr. Voetsch of the Utica Gas & Electric Company in a paper on that subject. The possibility of the use of two runners on one shaft to increase speed characteristics is one possible development.

The selection of oil circuit breakers, said H. A. Travers, Westinghouse Electric & Manufacturing Company, depends on the characteristics of the breaker and of the system the circuit is to be used on.

Systematic line inspection was a topic that evoked a considerable discussion at the Thursday morning session. All companies reported on the methods in use, and it was the consensus of opinion that periodical inspection of poles in use on low-voltage power lines was more desirable. Continuous or at least weekly patrolling of high-tension lines was likewise important.

The members made an inspection trip to the Trenton Falls plant of the Utica Gas & Electric Company on Wednesday afternoon, June 23. On Thursday afternoon J. A. Vahey of the Boston Edison Company gave a demonstration of the Lundin fault locater.

Electric Light and Power Financing During First Half of Year

JUNE, with a total of $22,903,000—the lowest since February—brings the total amount of financing by electric public utilities during the first six months of 1920 up to $172,501,440. Of this total $29,896,440 is in stock, and the balance of $142,,605,000 is in notes and bonds. A survey of these issues as they have appeared each month in the ELECTRICAL WORLD shows that the companies represented have had to pay well for the use of the money. That the interest rate and the percentage yield is still on an upward trend is also evident. Yields of a little over 7 in the first few months of the year have been followed by from 7½ to 8 per cent, until in June we find five bond issues offered at prices that net the investor from 7.64 to 8.12 per cent. Of the June total $6,103,000 is in preferred stock of the United Gas Improvement Company at 7 per cent, while two bond issues of $5,000,000 each, one in five-year notes of the Commonwealth Edison Company, the other fifteen-year first mortgage bonds of the Cleveland Electric Illuminating Company, form a large part of the balance. The details of the June issues follows:

Company	Amount of Issue	Period	Class of Security	Rate of Interest	Per Cent Yield	Offered at
Commonwealth Edison Co.	$5,000,000	Five-year	Collateral gold notes	7	7.82	97
Cleveland Electric Illuminating Co.	5,000,000	Fifteen-year	First mortgage bonds	7	7.64	95½
Idaho Power Co.	2,000,000	Ten-year	First lien and general mortgage	8	8	100
Shawinigan Water & Power Co.	4,000,000	Six-year	Secured convertible gold notes	7¼	8.08	97
El Paso Electric Co.	800,000	Five year	Gold notes	7	8.12	96
United Gas Improvement Co.	6,103,000		Cumulative preferred stock	7	7	50
	$22,903,000					

White Sulphur Springs Convention of A. I. E. E.

President Townley Speaks on Labor Conditions—Discussions on Generator Ventilation, Protective Devices and Other Technical Topics

OPPORTUNITY both to relax from the pressure of business and to exchange ideas on some important engineering questions of today was afforded at the thirty-sixth annual convention of the American Institute of Electrical Engineers, held this week at West Virginia's most attractive mountain resort, White Sulphur Springs. This was made possible by holding business sessions only during the forenoon of each day and devoting the afternoons to entertainment of various sorts. The convention, which met at the Greenbrier on Tuesday, with more than 200 delegates attending, was opened with an address by President Calvert Townley on "An Engineering Analysis of the Labor Problem" and the introduction of President-elect Arthur W. Berresford, who responded by pointing out the great responsibilities of the office and voiced the hope that the Institute might prosper during the new year.

The remainder of the first day's sessions was devoted to the annual reports of the technical committees, which marked a departure from custom this year by summarizing the features of the past twelve months' engineering developments. Abstracts of these reports are presented on pages 19 and 20.

On Wednesday morning nine technical papers were presented—five under the auspices of the electric machinery committee, B. A. Behrend chairman, dealing principally with large generator failures and generator ventilation, and four on miscellaneous subjects.

After the technical committee reports there was a discussion on the relation of the A. I. E. E. to the Association of Iron and Steel Electrical Engineers, the Institute of Radio Engineers and other allied societies. Prof. D. C. Jackson contended that the A. I. E. E. should deal chiefly with the scientific aspects of electrical engineering, leaving commercial problems to specialized societies. It appeared to be the consensus of opinion that the A. I. E. E. should act as a clearing house for all electrical societies and deal with the problems of all the electrical industries co-operating with allied societies.

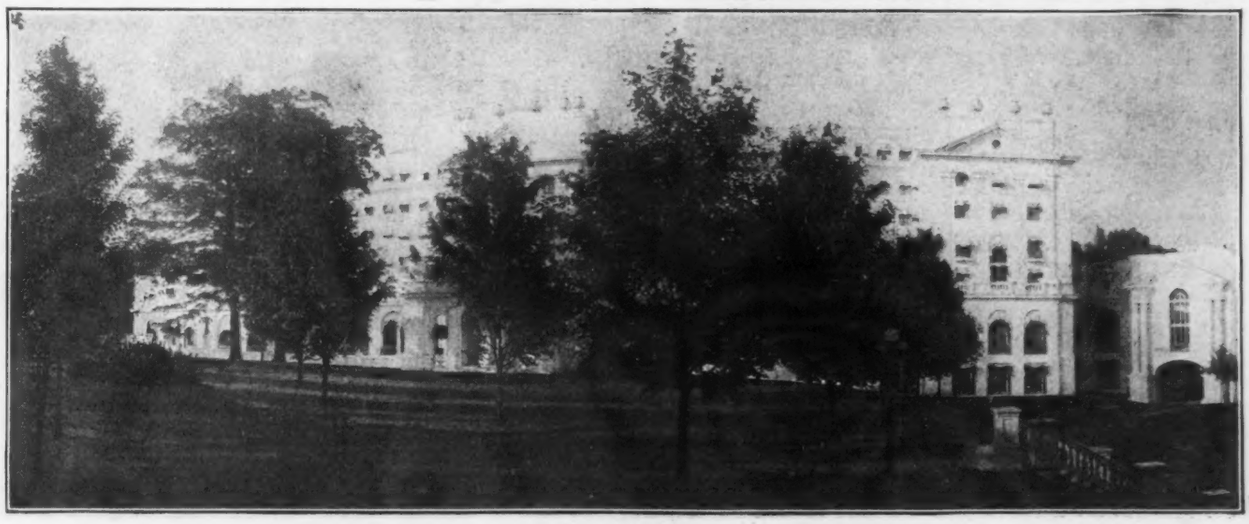
Wednesday evening there was a conference of section delegates and officers. Thursday morning a most interesting session was held under the auspices of the protective devices committee, D. W. Roper chairman, at which the protection of large generating stations operating in parallel was discussed. Two of the most important papers at this session—those by R. F. Schuchardt and Dr. C. P. Steinmetz—are presented quite fully on pages 5 to 8. Electric welding and power factors were the subjects of the only evening business session Thursday, at which nineteen papers were presented. The last technical session was held Friday morning under the auspices of the power-station committee, Philip Torchio chairman, and was devoted to the consideration of which system of excitation has the greater advantages—the common bus or individual exciter.

Entertainment constituted no small part of the convention, afternoon teas being provided for the ladies each day, a piano recital by Prof. Vladimir Karapetoff, and automobile rides.

PRESIDENT'S ADDRESS

Calvert Townley, the retiring president, in addressing the convention, spoke on the relations between employers and employees. He declared that the strategic position formerly held by capital in its time-honored barter with labor had shifted until now labor had the upper hand and was itself becoming the oppressor rather than the oppressed, and he traced briefly the causes for this change of relationship springing from the war, the cessation of immigration and the coincident slackening of endeavor. He censored the labor unions because in their contracts with employers they provided no means by which the workmen could be penalized for violation except by the unions themselves. He held also that union workmen were making a great mistake in attributing their present-day success to their organization and failing to appreciate the part played by the law of supply and demand.

In conclusion Mr. Townley paid his respects to the profiteers, whose exorbitant charges he held to be a factor combining with abnormal wages to cause the prevailing era of high prices. He looked for this era to pass without bringing any material change in either the social order or the industrial structure of the nation.



GREENBRIER HOTEL, WHITE SULPHUR SPRINGS, WEST VIRGINIA

Alabama Power to Build 100,000-Hp. Hydro Plant

AS A RESULT of President Wilson's signing of the water-power bill the Alabama Power Company is planning to begin the construction of its five-million-dollar power plant at what is known as Duncan's Rifle, on the Coosa River, near Gadsden, Ala., some time before Aug. 1. The project was surveyed by the engineers some time ago. The dam across the river will be 72 ft. (22 m.) in height and develop between 90,000 hp. and 105,000 hp.

Broad and Liberal Policy Recommended in Education of Farm Users

"VALUATION and Rate of Return," "The Determination of Electric Service Rates" and farm-line committee report were discussed as closely related subjects by an enthusiastic gathering at the nineteenth annual convention of the Iowa Section of the National Electric Light Association at Colfax, Iowa, June 23, 24 and 25. The serious situation in rural distribution from the entire rate standpoint was clearly illustrated by the statement of Arthur Huntington of Cedar Rapids, who on applying the rates of eight leading Iowa and Nebraska cities to a 20-hp. motor operating at 6, 12½, 35 and 70 per cent load factor showed minimum charges ranging from nothing to $45 per month and energy charges from $26 to $60, $40 to $73, $80 to $160 and $137 to $295 per month for the four load factors. In four cities the same charge for a 20-hp. motor operating at 70 per cent load factor and a 100-hp. motor operating at 14 per cent load factor was found in face of the fact that the equipment investment for the larger motor is several times that for the smaller motor.

A broad and liberal policy of advice and help to the farmer in the purchase of his equipment and the use of the best of materials, substantial construction, safety-first equipment and the grounding of neutrals was held by the committee to be necessary. Care and patience in educating the farmer in the common technical details and the keeping of transformer sizes to the minimum to lessen losses are important items for consideration. Fly-by-night contractors are creating a serious situation because of the flimsiness of the lines they build.

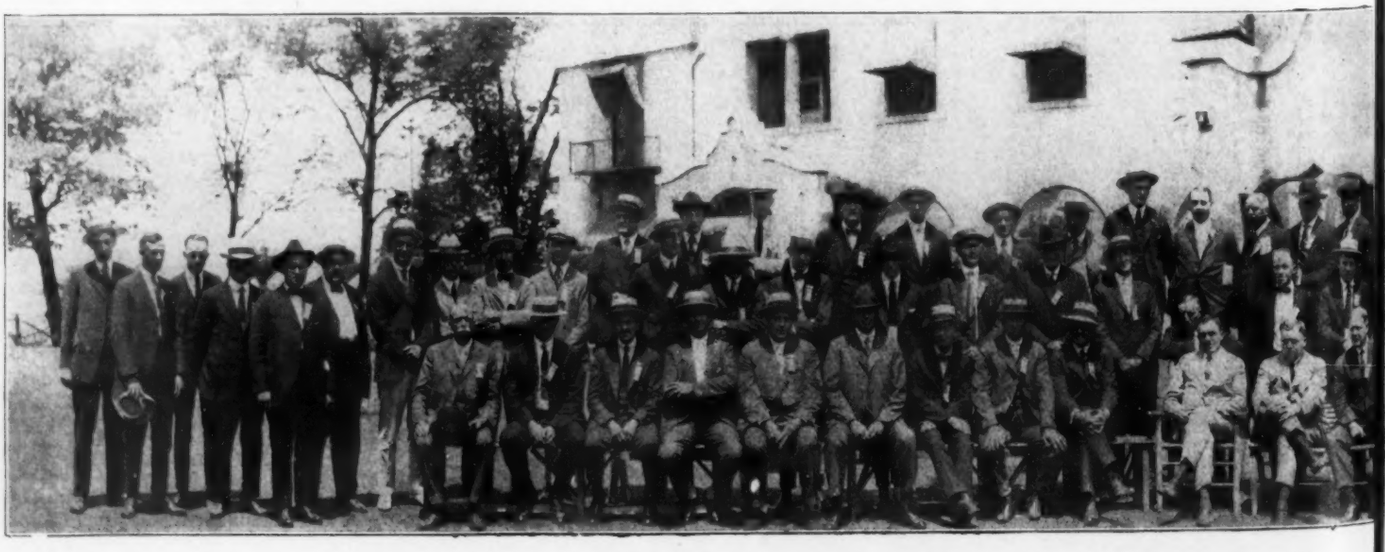
The tendency in Iowa at the moment is toward the formation of rural utilities, but in the sample forms of contracts submitted provision was made for the public utility to have first opportunity of acquiring the rural lines in case of sale. The discussion developed a strong sentiment against the formation of such companies. The financing of construction, it was unanimously agreed, must be done by the farmers. In two forms of contract suggested a three-part rate was presented. While sentiment was divided, a strong feeling that the lines must be under control of the utility furnishing service was manifested, as was also a very strong sentiment for the fixed charge or "readiness-to-serve" rates.

Pointing out that a complete valuation should contain at least the cost of developing, value of physical property, miscellaneous construction expenses (overhead items), going-concern value and working capital, B. J. Denman cited court decisions supporting the contention that these are proper items.

That the time has arrived when some uniform method of determining rates must be devised was urged by W. J. Greene in presenting "The Determination of Electric Service Rates." The necessity for the multiplicity of rates shown in the National Electric Association rate book was questioned. A form of rate consisting of a primary rate sufficient to cover the consumer and demand charges when applied to a predetermined number of kilowatt-hours for a given class of consumers and an excess rate for all energy in excess of that charged at the primary rate was advocated. A minimum charge would be a part of the rate. In the discussion issue was taken with the form of rate suggested and a decided preference for a "readiness-to-serve" form of rate was indicated. It was found that minimum charges and high energy rates tend to encourage consumers to use only the minimum amount of energy.

E. V. Graham outlined methods of placing utility securities among customers. Sutherland Dows described the plan of the Iowa Railway & Light Company.

The new officers elected for the section are: President, F. J. Hanlon, Mason City; vice-president, C. N. Chubb, Davenport; second vice-president, Sutherland Dows, Cedar Rapids; secretary-treasurer, M. G. Linn, Des Moines; executive committee, C. H. Stimonds, Dubuque; David Daly, Keokuk; F. H. Brooks, Omaha, Neb.; Clarence Macy, Adel; A. W. Jones, Paterson; J. M.



DELEGATES ATTENDING THE NINETEENTH ANNUAL CONVENTION OF THE

Drabelle, Cedar Rapids; Austin Burt, Waterloo; Don Sterns, Humboldt; Paul P. Myers, Grinnell; H. Bellamy, Knoxville, and David G. Fisher, Davenport.

Thursday evening was devoted to the annual banquet, at which an address was made by M. H. Aylesworth, executive manager of the National Electric Light Association.

Holyoke Municipal Plant Adds Lighting Service Charge

A SERVICE of 50 cents per month per meter will be levied upon gas and electric consumers by the municipal lighting department at Holyoke, Mass., beginning July 1. John J. Kirkpatrick, manager, states that increased costs of operation necessitate this charge and that without it substantial advances in the meter rates would be necessary. About 10,000 electric meters are affected.

Washington Commission Orders Power Company to Reduce Rates

THE Public Service Commission of Washington has ordered the Puget Sound International Railway & Power Company to reduce its rates on electricity sold for power and lighting purposes so that the company will be earning 8 per cent on the valuation of its properties instead of making 43.6 per cent on its power rate and 11.61 per cent on its lighting rate as at present. The company has challenged the jurisdiction of the commission over electricity sold for power purposes, claiming that a Supreme Court decision in a former case held that the sale of surplus power should not be considered a public use subject to commission regulation.

The Puget Sound International Railway & Power Company operates in and around Everett, Wash., and in handing in its ruling the commission stated that it found the rates as existing at present unreasonable and more than sufficient. The commission directed the company to file within ten days a reduced schedule of rates applying to all light and power service which will yield 8 per cent upon the valuation fixed by the commission for the light and power systems singly and combined as of Dec. 31, 1918, with net additions and betterments up to June 1, 1920.

The company is also directed to file with the commission within twenty days copies of all contracts with light and power users that are in conflict with the new schedule of rates to be fixed pursuant to the reduction order. The city of Everett is also directed to file certified copies of franchises and contracts with the company.

Vermont Valuation Based on Ten-Year Average Price

INCREASED power rates established by the Montpelier & Barre (Vt.) Light & Power Company, as a result of higher costs of operation, have been approved by the Vermont Public Service Commission in an exhaustive decision recently issued. The case is one of the most important in the history of the commission and has been followed with great interest in view of the emphasis laid by both sides upon the determination of the rate base. The company is operated by Charles H. Tenney & Company, Boston. Carver, Macomber & West, Boston, engineers, and Sanderson & Porter, New York, made a valuation of the property for the company.

The new rates are 0.5 per cent kilowatt-hour in excess of those in force in June, 1918, which were about 10 per cent in excess of the rates previously in effect. The commission holds that 7 per cent upon the present value of the property devoted to public service is a fair rate of return in this case and fixes the rate base at $3,300,000. It points out that capital for hydro-electric development in Vermont must be sought outside the state and that the rate of return must be sufficient to attract such capital. Included in the system are eight hydro-electric plants, eleven substations, 91.67 miles of transmission lines, a distribution system with 5,201 services, 1,150 transformers and 918 street lamps.

In this case available original costs were shown to represent only a small portion of the company's property. Neither reproduction cost on present-day units nor upon pre-war prices was regarded as equitable in fixing the rate base; instead, the board holds that a valuation based upon average prices for a ten-year period ended Dec. 31, 1919, gives as fair results as can be arrived at. An allowance of 15 per cent on overhead construction costs, including land values, is held fair as an overhead charge. An allowance of $150,000 was authorized for working capital.

IOWA SECTION N. E. L. A. AT COLFAX, IOWA, JUNE 23, 24 AND 25

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Northwest Interconnection. — The Portland Railway, Light & Power Company has started work on the construction of a 60,000-volt line from the present terminus of the transmission line at the River Mill plant to the plant at Willamette Falls, near Oregon City. A feature of this new line will be a 500-ft. span on steel towers over the Willamette River. The rest of the line is to be wood-pole construction with pin-type insulators.

Virginian Power Company Asks Further Increase.—Application to the Public Service Commission of West Virginia for an increase of 55 per cent on its rates as of September, 1919, has been made by the Virginian Power Company of Charleston, whose power plant is at Cabin Creek Junction. In the month named this company received permission to raise its rates 40 per cent, but it claims that this increase has proved inadequate.

"Electrical Home" Meets Popular Approval.—The "electrical home" recently opened by the San Francisco Electrical Development League and the Mason-McDuffie Company in San Francisco was visited by more than 2,000 people in the first three days. This house, which is equipped with electrical appliances and is fully furnished, has been widely advertised and is proving of much service in showing the public the value of electrical outlets in private residences.

Philadelphia to Charge for Permits to Lay Conduits.—The Philadelphia Department of Public Works is drawing up a schedule of charges for permits to private concerns to lay conduits under city streets. The attitude taken by the administration is that the tearing up and use of streets for the installation of underground structures causes inconvenience to the public and that the city should be reimbursed for granting such privileges in cases where the advantage derived is purely a private one.

Electricity in Denmark.—There are 497 central stations in Denmark with a total output of 108,000,000 kw.-hr. a year, which it is thought could be increased to 450,000,000 kw.-hr. with cheaper energy. Hence the scheme of obtaining power from Norwegian waterfalls continues to attract serious attention. The distance from the nearest suitable falls to Copenhagen is about 75 miles, and it is proposed to transmit 26,000 kw. at 50,000 volts by an overhead line running through Sweden to Malmo and thence by submarine cable across the sound to the Danish capital. The engineering difficulties could be easily overcome, the chief obstacle being that of obtaining a good load factor.

Economy of Electric Operation of Mines.—In a paper read before the Yorkshire (England) branch of the Association of Mining Electrical Engineers, J. R. Haigh, a colliery engineer, asserted that by the application of electricity to a colliery nearly $1,000 a week had been saved in boiler consumption alone. The coal mines of the future, he declared, would be laid out for complete electrical operation, direct steam power and animal traction being dispensed with.

Hydro-Electricity in British India.—A project for hydro-electric development is under way in Bombay, India, which involves damming the Nila and Mula Rivers at their junction, thus taking advantage of a fall of 1,750 ft. A power station will be built at Bhira, 70 miles from the city of Bombay, whither energy will be conveyed over 100,000-volt transmission lines. The installation will have a total capacity of 150,000 hp., of which 75,000 hp. is to be developed in the first instance.

Pulverized Coal and "Colloidal" Fuel.—Trials of pulverized coal in the form both of dry dust and of colloidal fuel, or powdered coal suspended in thick oil, which have recently been made on an English railroad have a bearing on the efficiency of these fuels with stationary engines. The trials, which were made in comparison with ordinary coal, showed that the special fuels could easily maintain a full head of steam with a high degree of superheat even on heavy grades and sharp curves. Economy in the matter of cleaning and repairs and less waste of fuel during delays were also shown.

Electrical Development Under New British Act.—The first action taken by the electricity commissioners appointed under the new electricity supply act in Great Britain has been to determine provisionally a separate electricity area in the west of England to be known as the Lower Severn Electricity District. Its area, says the London *Engineer*, covers about 2,000 square miles, its extreme dimensions being roughly 75 miles north and south by 50 miles east and west. The cities of Bristol and Swindon will be included in this district. In marked contrast with its comparatively rural nature will be the area of about 2,500 square miles involved in a recently announced scheme for linking up the Northwest Midlands. That area takes in the Black Country and the industrial areas around Wolverhampton and Birmingham, but excludes the latter city. This plan, besides interconnecting existing systems, would erect for immediate purposes a 20,000-kw. station at Stoke-on-Trent, with two other stations to follow, and provide for future power requirements of from 200,000 kw. to 250,000 kw., as compared with existing capacity of 100,000 kw.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

A. I. E. E., Toronto Section.—Frank Ewart has been elected president and Perry A. Borden secretary of this section.

Madison Section, A. I. E. E.—The election of officers for the coming year at the last meeting of this section resulted as follows: Chairman, G. C. Neff; secretary, H. M. Crothers. F. R. Winders was elected as the third member of the executive committee.

A. I. E. E., Pacific Coast Sections.—A few changes in the program of the convention of the Pacific Coast sections of the Institute, to be held at Portland, Ore., July 21-24, as published on page 1019 of the ELECTRICAL WORLD for May 1, have been made. On July 21 F. W. Peck will present a paper on "Electrical Characteristics of the Suspension Insulator at the Higher Voltages," the paper by D. M. Jones on "Power-Factor Correction on Distribution Systems" being transferred to July 23. "Bridge Methods for Alternating-Current Measurements" will be discussed by D. I. Cone on July 22. L. R. O'Neil will deal with "Use of Special Steels in Pressed-Steel Transmission-Line Fittings" on July 23.

St. Louis Electrical Board of Trade.—The first year's operation of the St. Louis Electrical Board of Trade virtually ended with the recent election of officers for the year beginning Sept. 1. The organization has increased its membership from 160 to 370. It was instrumental in preparing a bill making the city electrical inspection department self-supporting, and succeeded in keeping provisions obnoxious to contractors out of the ordinance. St. Louis manufacturers have been helped, and incidentally money has been saved to the city, by the action of the Board of Trade which resulted in a change in the cable specifications of the city whereby all manufacturers are able to bid instead of only one company. The officers elected for the ensuing year were: C. E. Michel, president; H. D. McBride, vice-president, and F. B. Adam, treasurer. Six members were elected to the executive committee: L. H. Egan, representing electric light and power companies; E. D. Smith, electric railways; J. S. Tritle, manufacturers; W. L. Rose, engineers and manufacturers' agents; A. C. Brandt, dealers, and F. D. Phillips, jobbers. Five members of the executive committee, representing consulting engineers, contractors, telephone and telegraph companies, railroads and research, hold over until next year.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Uniform Cash Deposits Inequitable.—The requirement of a cash deposit of $5 from every consumer is inequitable, in the opinion of the Montana Public Service Commission. The utility should conform to the rule that the deposit shall equal but not exceed one and one-half times the average monthly bill of the consumer, it having the power to discontinue service on the fifteenth day of the month following the month of service if payment has not been made.

Objections to Variable Rates.—In granting to subsidiary companies of the Missouri Public Utilities Company the right to add a surcharge of 20 per cent to their pre-war rates, the Missouri Public Service Commission criticised a proposed variable-rate schedule on the ground that to change the rates from a basic figure as the cost of fuel, labor and taxes vary may cause a greater change in the rates than the change in the cost of furnishing the service, because the cost of service is made up of items other than those included under fuel, labor and taxes, and a variable rate does not permit of definite knowledge of the charge at which service is being furnished.

Advisability of Limited-Hour Service for Small Utility.—In granting an increase of rates to the city plant of Culbertson, Mont., the Montana Public Service Commission, while refraining from interference with the project of the manager to establish remunerative twenty-four-hour service, he being willing to bear the loss of a fair return on his investment in order to make the attempt, pointed out that were the service reduced to ten hours a day, with special arrangements to meet the requirements of housewives on Mondays and Tuesdays, a material reduction in operating expenses would be obtained with only slight reduction in revenues. The practice of furnishing free energy to the manager's residence the commission declared illegal, and its discontinuance was ordered.

Special Rates to Schools Discriminatory.—Special rates for electric service to a municipal school district are not justified on the ground that it is a public corporation supported by taxation, according to a decision of the Missouri Public Service Commission in a complaint of the school district of St. Joseph against the electric utility supplying that city. The status of a school district is the same as that of private consumers; nor may the cumulative consumption of all its schools be held to bring it under the lesser rate chargeable against large consumers, because the cost of each service is virtually the same as the cost of furnishing individual customers. A school district can qualify as an off-peak consumer only where it receives its service during off-peak hours entirely.

Standard Frequency Rule in New Hampshire.—Five per cent variation above or below the standard frequency has been specified by the New Hampshire Public Service Commission as the normal limit of fluctuation to be permitted by public utilities, but momentary variations in excess of the foregoing are permitted by the commission when these are clearly due to no lack of proper equipment or reasonable care.

Preserving Proper Margin Between Revenue and Outgo.—The Arizona Corporation Commission has ordered an increase in the rates of the Desert Power & Water Company, although it appeared that the company had during its existence earned more than $53,000 in excess of its depreciation requirements, operating expenses and a 10 per cent return upon the value of the property as accepted by the commission. The increase was granted because of the increase in operating expenses, which, in the commission's opinion, prevented there being at the present time a satisfactory margin between the total revenues and such operating expenses.

Inequity of a City Tax on Utility Revenues.—In passing upon an application by the Eastern Oregon Light & Power Company for a new schedule, the Oregon Public Service Commission took occasion to condemn the action of the city of Baker, which is served by the company, in imposing upon it a franchise tax amounting to 3 per cent of the gross revenue of the utility within that city. This action, the commission said, by making operating expenses in Baker higher than those in other places served by the company, threw an unjust burden on the other communities, and to remove the discrimination it would be necessary either that the franchise tax be abolished or that the Baker rates be increased sufficiently to compensate the company for the extra cost.

Idaho Power Company Gets Increase in Oregon.—Following the lead of the Public Utilities Commission of Idaho (see ELECTRICAL WORLD, June 19, page 1444), and as a result of joint hearings held with that commission, the Public Service Commission of Oregon has granted to the Idaho Power Company an increase of 10 per cent on lighting and power rates and of 20 and 25 per cent on new irrigation pumping contracts in the State of Oregon. These increases constitute an emergency order and are to remain in effect for one year pending a valuation of the company's property. The commission declares that it grants them in recognition of the fact that the revenues of the company are so low that under existing rates it cannot raise the funds for necessary additions to take care of increasing demand.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Action by Commission a Prerequisite to Raising Contract Rates.—In an action brought by the village of Freeport, N. Y., against the local gas company, the Supreme Court of the state has declared that the public service commissions law does not authorize a public utility company having a contract with a municipality to increase its rates by filing a schedule without action by the commission. (181 N. Y. S. 830.)

Commission's Rate-Fixing Powers—Equal Protection—Franchises Not Property.—According to a decision of the Appellate Division of the New York Supreme Court, in Bronx Gas & Electric Company vs. Public Service Commission, First District, when a rate fixed by statute has been held invalid as confiscatory, a provision of the statute creating the commission that it shall not fix rates exceeding those fixed by law is abrogated and the powers delegated to the commission to deal with cases where no statutory provision exists come into effect. The law is not unconstitutional as denying equal protection merely because the Legislature has fixed rates in one locality while delegating to the commission the power to fix rates in other localities, the commission finds; and it also asserts that franchises from the state are not property devoted to the public use upon the value of which the utility is entitled to a return. (180 N. Y. S. 38.)

Franchise Rights, Consent of Municipal Authorities and Right to Injunction.—In the case of Holland Realty & Power Company vs. City of St. Louis, the Supreme Court of Missouri found that the ownership of fee in an alley and of franchises from the state did not permit a corporation to lay wires without the consent of the municipal authorities, which by law meant the consent of the legislative authorities acting by ordinance and could not be granted by administrative officers. A mandatory injunction at instance of a city to require an electric company to remove wires placed under an alley may, however, be properly denied as restraining violation of a technical right from which no damage would ensue and operating oppressively. The Supreme Court therefore reversed the action of the court below in granting an injunction to the Holland company which prevented the city from interfering in any way with the company's wires, but sustained the lower court in refusing to grant the counter-injunction asked for by the city to force the company to remove its own wires. (221 S. W. 51.)

Men of the Industry

Changes in Personnel and Position—Biographical Notes

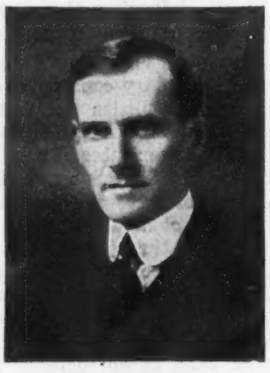
Wiley F. Corl of St. Louis, Mo., has severed his relations with the Southern Illinois Light & Power Company, of which he was vice-president in charge of operation, and purchased a one-third interest in the Mexico (Mo.) Power Company, of which he is now general manager and secretary. For about two years after graduating from the University of Missouri in 1908 in electrical engineering Mr. Corl held minor positions with the Joplin & Pittsburgh (Kan.) Railroad Company and with the Empire District Electric Company of Joplin, Mo. During the next four years he was engaged in design, construction, appraisal and report work for the Arnold Company, consulting engineers of Chicago. Then he became electrical engineer of the Allen & Garcia Company,

W. F. CORL

consulting engineers of Chicago, where he specialized on coal-mine electrical problems. Through this work he became acquainted with J. J. Frey of Hillsboro, Ill., president of the Southern Illinois Light & Power Company, whom he joined in an undertaking to supply coal mines with central-station service. While with the Southern Illinois company Mr. Corl had charge of all operating and construction work in connection with the electric, gas, water, steam-heating and ice plants from which some sixty-five different communities in southern Illinois were finally served. Mr. Corl was chairman of the transmission and distribution committee of the Illinois State Electric Association and is well known as one of the first in the state to recommend small companies to expand by building extensive high-tension lines and outdoor substations.

John I. Beggs, who has been re-elected president of the Milwaukee Electric Railway & Light Company after a lapse of nine years, is essentially a financier. Mr. Beggs was in the insurance business in Harrisburg, Pa., when in 1883 he organized, installed and operated the Harrisburg Electric Light Company, which was among the first of the Edison licensee companies. The results obtained at Harrisburg attracted attention and 1886 he was called to take the post of vice-president and general manager of the Edison Electric Illuminating Company of New York, which, though small compared with the central stations of today, was then the largest in the world. Operating problems continued to occupy all of Mr. Beggs' attention until 1890, when, upon the formation of the Edison General Electric Company, he was appointed manager of the central district with headquarters in Chicago. It was while in this position that Mr. Beggs helped to build the Milwaukee traction lines, which he later operated at a profit after others had considered this an impossibility. After a period of three years in Chicago he returned to New York, this time with the General Electric Company, retiring a few months later. Before he had a chance to indulge in much rest or traveling he was prevailed upon in November, 1893, to go to the assistance of the Cincinnati (Ohio) Edison Company, which was suffering severely on account of competition from the gas company and had defaulted on a contract. Some months after the Milwaukee Electric Railway & Light Company went into bankruptcy and he agreed to act in an advisory capacity for that company also. In February, 1896, it was returned to its stockholders, but by September Mr. Beggs was again called into consultation. This time he was elected president and general manager of the company and for the next ten years the property increased its earnings 10 per cent each year compared with the earnings of the previous year. In about 1902 the North American Company became interested in St. Louis public utilities and for a number of years Mr. Beggs was directing its Cincinnati, Milwaukee and St. Louis properties. In 1909 Mr. Beggs again gradually retired from active management in North American properties only to be recalled as president of the Milwaukee Electric Railway & Light Company, on the resignation of J. D. Mortimer a few months ago. As Mr. Beggs became less active in the North American properties he became more interested in other properties in Wisconsin. He has directed the operation of the Wisconsin Traction, Light, Heat & Power Company since about 1897 and in 1915 he acquired control of the Southern Wisconsin Power Company, with a hydro-electric development at Kilbourn, and the Wisconsin River Power Company, with a water-power plant at Prairie du Sac. In connection with the two latter companies the Wisconsin Power, Light & Heat Company was organized to create a market for the energy generated. The controlling interest in the two hydro-electric companies and in the distributing organization was sold within the past few years to the Insull interests, but Mr. Beggs is still a director.

T. D. Crocker, the re-elected president of the North Central Division of the National Electric Light Association, is assistant vice-president of the Northern States Power Company in Minneapolis in charge of operation. When the new geographic section organization was launched Mr. Crocker was selected to head the section representing the Dakotas and Minnesota, and his broad-minded view and grasp of public utility problems has been a large factor in the successful launching of the work of this division of the national association and the recent enthusiastic



T. D. CROCKER

convention at Minneapolis. Mr. Crocker was born in Elyria, Ohio, Oct. 8, 1878. For two years prior to going to the State University of Ohio he was with the Lincoln Electric Company, Cleveland. Upon graduation in 1904 as an electrical engineer he became connected with the Milwaukee (Wis.) Electric Railway & Light Company. In 1912 he entered the employ of the Northern States Power Company, with which company he has been associated ever since.

Obituary

Arthur C. Walworth, formerly mechanical engineer of the Walworth Manufacturing Company and later president of the Walworth, English & Flett Construction Company, houses widely known in the engineering field, died at Newton Center, Mass., June 23, at the age of seventy-six. He was a native of Boston and was educated at Yale.

E. S. Fletcher, assistant general manager of the Texas Power & Light Company, Dallas, Tex., died June 9 following an operation at Temple, Tex., his former home. Mr. Fletcher had been assistant general manager of the company for eight years and prior to that time was manager of the company's plant at Temple for a number of years.

Trade and Market Conditions

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods

New Canadian Firm Will Manufacture Hydraulic Turbines

RATHER than import much of their machinery and other apparatus from the United States and Europe, as has been done in the past, power and paper manufacturing interests in Canada have organized the Dominion Engineering Works, Ltd., of Montreal, Que., which has entered into an agreement with the William Cramp & Sons Ship & Engine Building Company of Philadelphia for the exclusive use in Canada and the British Empire of the I. P. Morris designs for waterwheels and other hydraulic machinery. Through this association and the acquisition of the paper-machine business and equipment of the Dominion Engineering & Machinery Company at Lachine, Que., the Dominion Engineering Works expects to be in a position to supply most recent designs in such equipment and of any size to meet Canadian requirements. Other lines of manufacture will include hydraulic valves, governors and other accessories involved in hydraulic and paper-mill installations and centrifugal and other pumps.

Those who have organized the Dominion Engineering Works are interested in plants requiring large electric generating units, according to a statement made to a representative of the ELECTRICAL WORLD by J. E. Aldred, president of the Shawinigan Water & Power Company, who is also interested in the new concern, and for this reason later on may extend its operations to the manufacture of this type of apparatus.

The company has booked orders for waterwheels and paper-mill machinery which will keep it busy for the next year. Among the additional hydro-electric installations to be made by the various Canadian companies for which the Dominion company will manufacture hydraulic turbines, Mr. Aldred said, are two 30,000-hp. units at Shawinigan Falls for the Shawinigan Water & Power Company, two 20,000-hp. units at Grand Mère on the St. Maurice River for the Laurentide Company, Ltd., and two 15,000-hp. units at Cedar Rapids on the St. Lawrence River for the Montreal Light, Heat & Power Consolidated.

Producers Divided on Raising Schedule Material Lists

JUST over a year ago the Electrical Supply Jobbers' Association, in convention at Hot Springs, passed a resolution to the effect that it was of the opinion that manufacturers of schedule material should sufficiently increase their list prices to obviate the necessity of quoting "plus list." The jobbers, individually, felt that through the method of adding discounts to list prices considerable confusion was resulting in their accounting and clerical departments and many mistakes were being made.

During the past year the jobbers have had little satisfaction from any results attendant upon their resolution, and they are still of the opinion expressed at that convention. An attempt has been made recently to get an answer from the manufacturers on the point at issue. To date three manufacturers have raised their list prices on schedule material to obviate plus discounts. Among the others opinion is divided.

Of those who answered a questionnaire sent to them—and the percentage of replies was not large—there is a feeling that present prices are at a peak and that the occasion for raising lists soon will no longer exist. At this time there is visible no evidence of a drop in prices of this material. A permanent adjustment of the situation, it was stated in one case, would be unwise in order to take care of a temporary need. At the same time, it hardly seems that a permanent adjustment would necessarily be effected in the raising of list prices at this time.

From at least one quarter comes the realization of the necessity of increasing the list prices to avoid the present complication of selling goods at list plus, and it is probable that a revision in list prices will be made in this case in the early fall.

Good Demand for Motor-Driven Chain Blocks

GENERALLY speaking, shipments of electrically-driven chain blocks can be made from stocks which are in dealers' and distributers' hands throughout the country. Manufacturers are ordered up above their present production capacity but are able to make factory shipments in about five weeks. Stocks of raw materials are in fair shape, but stocks of motors are not so good. Considerable difficulty is still being experienced in getting enough motors, and this is the main feature lengthening shipments. At the same time, the motors are so standardized that few different styles have to be kept, and therefore greater ease of stocking is experienced.

Demand for chain blocks is good and is tending constantly to the use of motor-driven blocks. Prices have been holding rather steady during the last six weeks, but it would not be surprising to see an advance, because that is the direction any change would take, it is understood from the manufacturers.

Supply of Steel Products Affected by Labor and Traffic

STILL further adverse conditions are being met by the steel interests. Unless wage adjustments are made between the sheet and tin plate mills which operate under union conditions and the Amalgamated Association, which comprises the workers of those mills, a shutdown is liable to result in those properties. The last wage agreement expired June 30, and at this writing there is no assurance that a new agreement is in force or how soon one will be placed in force.

Of especial interest in this connection is the effect a shutdown of these mills will have on the steel output for the electrical trade. Outlet boxes are in very poor supply today and the immediate outlook is not too bright. Production has been at a low figure for the last few months, while the manufacturers have been forced to substitute any kind of sheet for boxes that they could get. This frequently meant punching from whole-sheet stock instead of from strip. Certain mills are unable to make any shipments at all on a hurry order. Shortage is also being felt in sheet stocks for switch boxes and cabinet boxes. Although shipments of rigid conduit are coming in, what amounts to virtual embargoes are being placed on steel shipments coming into certain Eastern states. The coal priority order just placed in force by the Interstate Commerce Commission is taking even the open cars which steel tube mills have been forced to resort to for shipments when box cars and cattle cars became scarce. Even the open-car shipments were unsatisfactory at best because of danger of loss from rain and theft. But they were better than no cars.

Flexible armored conductor is not so liable to be affected either by sheet-mill labor troubles or by coal priorities on cars. Embargoes in the East have been providing considerable embarrassment to shippers of steel strip, and this material, and frequently also the finished conductor, have been and still are being shipped by express and motor truck. Demand in the East is lessening a bit because of a slight falling off in building requiring this material, but in the Mid-West and West the demand is still high. If these conditions remain in this relation for a time, it would not be unreasonable to expect a larger flow of armored conductor to those sections where the need is greater and away from an easier market. This material is on about an 80 per cent production schedule at this time.

Conditions Uneven in Bare Copper Wire Market

MANUFACTURERS differ on conditions of the bare copper-wire market. On one side it is declared that demand is rather quiet with few orders for export coming in. Domestic demand, however, is fair with little heavy construction work being undertaken. On the other side of the question it is asserted that the volume of orders is large, while at the factory there is underproduction owing to a shortage of raw material and labor. It is stated that production could be increased 60 per cent if sufficient men could be obtained to establish a night force of workmen

Finer sizes of copper wire are especially hard to obtain, and shipments take longer than for the coarser material. Large sizes average six to eight weeks, while the smaller stuff runs from four to six months, which is about three times longer than is normal.

The market has held steady for the past three or four months with no prospect of fluctuation in sight, but if any change occurs the probability seems to point to its being upward. Bare copper wire is averaging about 22 cents base. Manufacturers report very few cancellations of orders, and collections are fair, most customers paying within the thirty-day or sixty-day time limit.

Metal Market Situation

TRADE in all metals is at a very low ebb at present, the natural condition of midsummer dullness being exaggerated by strikes, the railroad and financial situations, and general business uncertainty.

A quiet domestic copper market is featured by the greater interest shown by consumers in future deliveries. Producers are encouraged by an increase of queries within the past few days which would seem to indicate a more active market. Producers are still firmly holding at 19 cents either for nearby or future deliveries. Standard spot copper developed a stronger tone at London as compared with the past few days, but is still £2 below the figures for June 22.

The lead situation shows great steadiness, with either not much lead to be had or else supplies strongly held.

NEW YORK METAL MARKET PRICES

	June 22	June 29
Copper	£ s d	£ s d
London, standard spot	86 15 0	85 15 0
	Cents per Pound	Cents per Pound
Prime Lake	18.50	18.50
Electrolytic	19.00	19.00
Casting	17.62½	17.62½
Wire base	22.50–23.00	22.50–23.00
Lead, trust price	8.00	8.00
Antimony	7.50	7.50
Nickel, ingot	43.00	43.00
Sheet zinc, f.o.b. smelter	12.50	12.50
Zinc, spot	7.90	7.95
Tin	50.50	49.00
Aluminum, 98 to 99 per cent	33.00	33.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	15.00 to 15.50	15.00 to 15.55
Brass, heavy	9.00 to 10.00	9.00 to 10.00
Brass, light	7.00 to 7.25	7.00 to 7.25
Lead, heavy	7.00 to 7.25	7.00 to 7.25
Zinc, old scrap	4.75 to 5.25	5.00 to 5.25

THE WEEK
IN TRADE

ALTHOUGH building operations are slack in the Mid-Western and Puget Sound districts, considerable activity is noted in the South, in New England and in California, with resultant large sales of electrical material.

Optimism seems to be the keynote of the business situation in general. Grain crop prospects on the Pacific Coast are reported good, while in the South a large increase of new industries is noted. The coal situation in New England is bad, though electrical utilities are in a preferential class.

Sales of fans are dependent upon the weather, Southern stocks being largely depleted by a heavy demand, while cool weather in Northeastern territory has been keeping stocks on the shelves. In the East lessened demand is felt for household appliances, but in other districts trade is brisk, with small stocks the rule.

Continued difficulty is experienced in all sections with shipping and receiving goods. Few price changes of any importance are reported. Collections are only fair, with considerable supervision of credits being exercised.

NEW YORK

No let-up in demand is noted as compared with the past few weeks, the market presenting a steady tone. Better results are found in the receipt of shipments from factory, but outgoing deliveries from jobbers are pretty poor. General shipping, however, is far below that required to satisfy the trade. Good results are being wrought by the Citizens' Transportation Committee in the clearing of freight which had tied up pier space. Because of priority coal movement, it is understood that embargoes on steel goods are on in the New York district.

Some large building enterprises have just been announced in the hotel field in Manhattan. One 2,000-room addition to the Commodore and one 3,000-room hotel to replace the Murray Hill are planned as well as an office building to replace the Manhattan Hotel. Home building in the suburbs is spotty but it is continuing on a fair scale. A great deal of wiring, however, is under way.

Fans are moving rather slowly because of unreasonable weather, and stocks are building up for the hot spell. Pipe stocks are bad and outlet boxes are found only here and there. Heating appliances are coming through only slowly. Conduit fittings, as condulets, etc, are in good demand, and the supply apparently is quite adequate.

Rigid Conduit.—Jobbers report that none is to be had, with large back orders wiping out very irregular shipments. Orders are being turned down. Prices for ½-in. black range from $86 to $100 per 1,000 ft., and for 1-in. black from $168 to $198, according to size of order.

Flexible Armored Conductor.—Stocks are coming in a little better but are still spotty, some jobbers reporting fair amounts on hand but they do not last long. Demand is a little lighter from some quarters but in general is heavy. From $105 to $115 is quoted for No. 14, two-wire, per 1,000 ft.

Rubber-Covered Wire.—Demand is good, and stocks are plentiful except for some small sizes. Shipments are coming through pretty regularly, one distributer stating that he is able to fill a 200,000-ft. order from stock. Price for No. 14 averages $11.50 per 1,000 ft.

Fans.—Demand varies, some jobbers' sales not having started strongly as yet, while others report a rapid turnover. Stocks are spotty, one company having recently received a heavy shipment of fans, while others are out of 12-in. and 16-in. sizes, which are especially popular. Ceiling fans are scarce and are in strong demand.

Non-Metallic Flexible Conduit.—Demand is inconsistent and stocks are spotty. Shipments are generally slow, one jobber receiving 5,000 ft. recently, his first shipment in three or four months. Quotations for the ½-in. size average, $32, and for the ¾ in. from $35 to $40 per 1,000 ft.

Outlet Boxes.—Stocks are in somewhat better shape than formerly, though shipments are only fair and average from six to twelve weeks. Demand is fairly good, and no price changes are reported.

Heating Appliances.—Trade is rather quiet because no shipments are being received, and stocks are in poor shape.

Fuses.—A good supply is on hand. Shipments are fair and demand varies, some jobbers selling more renewable fuses while others have their heaviest run on the non-renewable type. The 30-amp. size or under, of either type, is quoted at about 13 cents in lots of 100.

Conduit Fittings.—Stocks are plentiful, demand is good, and shipments are coming in well. This material has a very rapid turnover. The market has been steady.

Sockets.—Large supplies are on hand; while the demand is good, it has fallen off somewhat. The pull-chain type is still in most favor. Shipments are coming in better the past two weeks.

CHICAGO

A slight reduction in the gross amount of new business placed, firm prices and continued difficulty with the shipping and receiving of goods are features of the market in Chicago. Shrinkage of demand is felt mainly by those concerns dependent on the utility corporations for trade, and this is attributed solely to money stringency. Factories are sufficiently filled with orders to prevent this causing any worry, and they are not likely to do any price cutting so long as they continue busy at prevailing price levels.

Slow traffic is coming to be accepted as a matter of course. Dealers report that shipments formerly requiring from four to six days are now averaging thirty, and that the employment of "human tracers" is frequently necessary. The most trouble is experienced with shipments coming from New England points.

The local building industry remains quiet, and labor in general is reported in better supply.

Wire.—Local stocks are still very low. Shipments are moving from the factory with greater ease, but all receipts are at once applied on back orders. In general, insulated wires require eight to twelve weeks for delivery. Bare wire is available for prompt shipment.

Underground Cable.—With output booked up solid to almost the end of this year producers are not anxious for new business. Great difficulty is being experienced not only by factories in securing raw materials but in shipping finished work from the Eastern production points here. Recent metal market fluctuations have had no effect on prices.

Potheads and Underground Equipment.—Sales are limited only by the amount of goods factories can turn out. Porcelain shortage is complained of. Prices seem firm and no indications of an advance are seen.

Motors.—Local stocks show no improvement, but manufacturers report better conditions in raw-material supplies as well as a decided shrinkage in demand. Roth Brothers & Company are booking all orders requiring over ninety days for delivery on an open-price basis, with a guarantee that delivery price will not be more than 10 per cent above current quotations.

Lamps.—Lamp stocks continue to improve. A real decrease in the amount of new business in all classes of lamp sales is noted, and with supplies produced and transported at increasing speed conditions are rapidly approaching normal.

Electric Signs.—Manufacturers report a slight relief in the pressure of new business, which is welcomed as an opportunity to catch up on orders. Difficulty in securing raw materials, particularly steel products, has complicated their problems. Prices on miniature signs have just been advanced to cover rising costs.

Line Hardware.—Deliveries are very slow and stocks depleted almost to the famine point. The Hubbard Company has withdrawn its lists on everything except Pierce specialties, on which an advance of from 15 to 20 per cent is recorded.

Household Appliances.—Jobbers report no material change in conditions, as they are still unable to secure goods in sufficient quantity to fill orders. The retail trade reports a lessening in demand, both in small cash transactions and the larger partial-payment sales.

BOSTON

Summer dullness finds little reflection in jobbing or manufacturing circles. Leading houses report 50 to 100 per cent more business in dollars than last year to date, and the difficulty of securing material persists. Shipments of orders placed many months ago, however, are coming in weekly, and the immediate needs of the trade are being met reasonably well. Collections are not so good, and credits were very sharply watched last week. One jobber among the smaller houses made an assignment to the controlling interests in a larger house, but it is understood that the concern is solvent. Prices hold firm and stocks are improving in the main, barring small motors and weatherproof wire. Labor unrest continues to disturb production conditions. New construction work for industrial uses continues to go forward in many parts of New England. The coal situation is very serious, although electrical utilities are in the main better supplied than industrial plants.

Motors.—Stocks of small motors are swept practically bare. The factory city office of a leading manufacturer wired into district offices hundreds of miles distant for a 3-hp. motor a few days ago, so acute is the shortage.

Fans.—Pre-seasonal stocks have not yet moved out of the jobbers' rooms. Cool weather and high prices are deterring sales, but stocks are none too large.

Ranges.—Considerable activity is noted in hotel and club-type ranges, increasing cost of gas being a factor. Orders for ranges, however, must be placed many months ahead in planning a distribution campaign.

Wire.—Rubber-covered wire, No. 14, is in good supply, and is quoted at from $11.25 to $11.75 per 1,000 ft. in 5,000-ft. lots. Bare copper wire is selling on a 24-cent base and weatherproof on a 29-cent base. The latter should come through in better shape soon, in view of reported early resumption of work in Rhode Island.

Flexible Armored Conductor.—Stocks are well maintained, and No. 14 single-strip brings $110, double-strip $112 per 1,000 ft., in 1,000-ft. lots.

Cross Arms.—A healthy demand is being handled, with fair deliveries. In small lots, the six-pin, 7-ft. 9-in. fir arms sell for $1.95 each, and on lots of 3,000 a price of $1.62 per arm is quoted. The high cost of overhead work is a deterrent upon central-station expansion this year.

Non-Metallic Flexible Conduit.—Prices tend toward slightly lower levels, the ½-in. size being quoted at $33.50 per 1,000-ft. in 1,000-ft. lots, and the ¾-in. size, steady at $38.50.

Rigid Conduit.—Incoming shipments on old orders have given considerable relief to some jobbers. Stocks are not being thrown "wide open," however. Sub-normal supplies bid fair to rule for some time.

Sockets.—A plentiful supply is understood to exist throughout most of New England. Prices are very steady, the case lot quotations running at 50 cents net per socket on pulls, 28 cents for keys and 26 cents for keyless.

Household Appliances.—The market is in a curious situation, owing to the fact that many manufacturers are overloaded with past orders and that the demand for devices less essential from the labor-saving point of view seems to be easier. Shipments are coming into jobbing houses in bunches. The tendency is for considerable stocks to accumulate in many specialties, but vacuum cleaners and washing machines continue in great demand.

Portable Lamps.—Some of these are moving well, notably for summer-home use. A spurt in second-hand acquisitions may be expected about this time in retail circles in close touch with college towns.

ATLANTA

The electrical jobbing and contracting business in the Southeast shows every indication of continued prosperity. No dull times can be foreseen from the present position of the electrical industry. This is the consensus of opinion as voiced at the recent meeting in New Orleans of the Southern electrical jobbers, where optimism was the order of the day.

Reports from all over the district indicate a well-sustained building activity, which, of course, means continued demand for all classes of electrical material.

The municipal authorities of Augusta have passed a ruling requiring that all future installations of main-line switches shall be of the safety-switch type, and there is a tendency throughout the section to make this ruling unanimous by all the larger municipalities.

An unusual number of new industries is reported and there is a noticeable increase in the number of inquiries by foreign corporations seeking plant sites in this territory. The proximity of the raw-material market and the better labor situation here are largely responsible for the desire to obtain factory locations.

Panelboards.—An increase in price is to be noted on cabinet boxes, due largely to shortage in the supply of thin steel. The demand is very brisk from industrial plants and drop shipments are quoted at from three to seven weeks.

Exhaust Fans.—The warm weather has sadly depleted local holdings of fans, the Ventura type being particularly hard to obtain, though there are fair supplies of the Davidson fan on hand. Shipments are unsatisfactory, particularly in the single-phase variety.

Electric Hoists.—Manufacturers of this specialty report sales on the increase, receipts of orders for large dock winches being in evidence. Shipments are very satisfactory, varying from stock to twelve weeks, dependent upon size and type.

Fans.—The unusually warm weather throughout the section has made a tremendous inroad on fan stocks. Some jobbers' stocks are completely exhausted while others report only nominal assortments on hand. The oscillating fan in 12-in. and 16-in. sizes is especially popular.

Safety Switches.—The ruling of the various municipalities and the decision of textile mills for the installation of switches of this type have created a very brisk demand, two-wire and three-wire, 30-amp. size being the most popular. Stocks are in fair shape and shipments continue to hold up well.

Meters.—Local stocks of meters are almost exhausted, none of the 5 and 10-amp., two-wire size being available in the territory. Incoming shipments are quickly absorbed by back orders. The shortage is most acute in two-wire, 110-volt type, shipments of this size being quoted at from three to four months.

Knife Switches.—The popularity of safety switches has placed this article in an unfavorable position. Stocks are reported moving very slowly, orders being received only from the smaller centers.

Schedule Material.—A slight improvement is to be noted in this line, with the exception of material requiring porcelain, which is still very hard to obtain. Likewise there are no armored conductor connectors in the territory. Shipments of other classes of schedule material are reported slightly improved.

SEATTLE-PORTLAND

Sales in the Puget Sound district show a further downward tendency as compared with the past several weeks, especially in Seattle. This applies particularly to jobbers, as the sales of large retailers, while lower than ordinary, are still being maintained as well as could be expected with the existing shortage of stocks. Building in Seattle, both residential and commercial, is at a very low ebb, and sales of schedule material are naturally very light. Reports from the "Inland Empire" and Spokane especially state that while present high prices of material and labor prevail this district will not enter into building on a large scale. This condition also applies to cities in the Puget Sound section.

In a final drive for production prior to the customary mid-season close-down, the lumber industry last week operated up to within 2 per cent of normal. Mills and camps in this district as well as in certain parts of Oregon are making ready for a shutdown of from one to three weeks and will make extensive repairs.

Grain crop prospects are good. Reports from eastern Washington are particularly favorable. Portland district jobbers report that temporarily there seems to be a slight upward tendency in business. Washing machines are now coming through to Portland in a very satisfactory manner, and present stocks are in good condition. The manufacturers seem to have caught up in this line of merchandise. Other stocks continue in a sadly depleted state, although shipments are coming through from the East about as they have been for some time; but back orders consume any such stock at once. Contractors report that business is very quiet, but the work which is being figured is of a higher grade than for some time. Retail stores report in some cases a slight improvement in business. There has been an appreciable decrease in the sale of ranges since the last price increase. Trade seems to be principally in small devices such as toasters, percolators, etc. Collections seem to be very slow and few new credits are being placed.

Washing Machines.—The demand far outstrips available supply in this territory. Both jobbers and dealers have orders far in excess of what they can reasonably expect to receive from Eastern factories for months to come.

Household Appliances.—In the Seattle district dates for deliveries on percolators, waffle irons, toaster stoves and like merchandise have lengthened to about ten months. During the past month retailers practically cleared their shelves and jobbers' stocks are all but exhausted. Sewing machine demand is far beyond the supply that is expected to exist for some time to come.

SAN FRANCISCO

Building operations, which have slowed up to a certain extent in the bay region, are proceeding at a great pace in Los Angeles and the interior cities. Unexpected rains have given the coast and the interior valleys a drenching, though little harm was done except to the cherry crop. In the mountains, the effect of these warm rains was to melt some of the packed snow.

Schedule Material.—The building and opening of various model electrical homes in California cities is to a marked degree drawing the attention of owners and architects to the importance of proper baseboards and wall outlets. Dealers are reporting a big increase in the number of inquiries for special flush receptacles.

Fans.—Several jobbers carried over considerable fan stocks from last year, but these have been nearly all sold, together with the new stocks. In fact, there is a general dearth of fans, for the early hot weather along the interior valleys and southern coast has produced a heavy demand. There is an insistent call for ceiling fans beyond that which was expected.

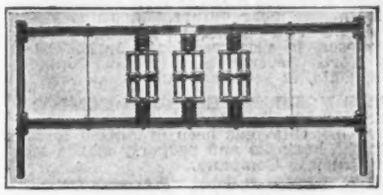
Household Appliances.—Banks and financial companies that make a specialty of handling the deferred-payment accounts of dealers in household devices report a marked increase in the amount of such sales handled through them during June. There seems to be an especial interest in dishwashers, although the various manufacturers have practically no stocks in this territory and do not expect any before the latter part of the year.

NEW APPARATUS & APPLIANCES

A Record of Latest Developments
and Improvements in Manufacturers' Products
Used in the Electrical Field

Busbar Support

Extra-heavy-duty busbar supports are being marketed by the Delta-Star Electric Company, 2433 Fulton Street, Chicago. They are particularly for use where in low-voltage distribution heavy currents are carried, and buses must



ELIMINATES HEATING ON HEAVY CURRENT SERVICE

be arranged, the manufacturer says, in order to avoid skin effect in the bars and to prevent hysteresis heating of adjacent iron parts. The accompanying bus support is for a three-phase, 60-cycle, 8,000-amp. circuit, wherein each phase is split up into four parts. Cross-beams holding the busbar insulators are of manganese bronze to eliminate heating.

High-Voltage Line Protective Apparatus

For working hot high-voltage lines with bare hands, the Bush Electric Company, Cleveland, Ohio, has developed a safety staging made of selected hard wood submitted to a

HIGH-VOLTAGE CIRCUITS MAY BE HANDLED WITH BARE HANDS

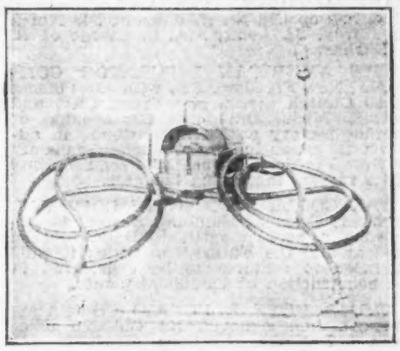
special drying and impregnating process. All insulated tools may be eliminated, the manufacturer says. Guards are placed to prevent accidental contact with grounded arms, guys or other circuits. It may be used on circuits up to 110,000 volts, it is claimed.

Single-Stage Amplifier

The International Radio Telegraph Company, New York City, is marketing its type RTA-104-A single-stage audio frequency amplifier. The amplifying transformer is hermetically sealed to keep out moisture. Variation in filament temperature changes the amount of amplification. Weight is 8 lb.

Pipe Thawer

The General Electric Company has placed the Wayne pipe thawer on the market with the idea of providing a portable device for thawing frozen water pipes electrically. It consists essentially of a transformer, consuming ordinarily about 550 watts, a 10-ft. lead for connection to the lighting circuit



PIPES THAWED FROM ALTERNATING-CURRENT LIGHTING CIRCUIT

and secondary leads equipped with cast-brass clamps for attaching to pipes from ¼ in. to 1 in. in diameter. Alternating current of 50-cycle to 60-cycle frequency and 100 volts to 125 volts is used. The spread of the secondary is 15 ft

Notes on Recent Appliances

Clothes Washer

An electric clothes washer on the rocking boiler principle is being marketed by the Remmert Manufacturing Company, St. Louis, Mo

Shadow Shield

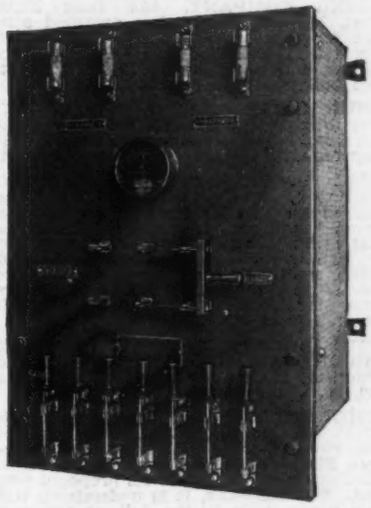
The Western Electric Company, New York City, is marketing a shadow shield for use with single-lamp fixtures.

Turbo Coupling

A fast flexible turbo coupling has been developed by the Bartlett Hayward Company, Baltimore, Md.

Battery-Charging Panel

The Meier Electric & Machine Company, 136 South Meridian Street, Indianapolis, Ind., has developed a battery-charging panel, 14 in. wide by 20 in. high. It is designed for 250 volts, direct current, having a maximum charging rate of 15 amp. in seven steps when connected to ninety cells in series. The same rate may be obtained from 125-volt service when connected to forty-five cells in series. The resist-



CHARGES FROM ONE TO NINETY CELLS

ance element is so proportioned that a single 6-volt battery may be charged. In this case the maximum charging rate for each unit switch will be 5 amp., the manufacturer asserts, or a total of 30 amp. with all unit switches in use. Resistance units are used in parallel.

Service Fixture Cover

For use with 4-in. round or octagonal outlet boxes, the Appleton Electric Company, 218 North Jefferson Street, Chicago, has developed a new swivel fixture cover. This cover accommodates a ½-in. conduit and owing to the swivel

FIXTURE HANGS CORRECTLY REGARDLESS OF OUTLET-BOX ANGLE

feature enables the fixture to hang correctly, says the manufacturer, even though the outlet box be installed at an angle or becomes jarred in any way.

MANUFACTURERS' ACTIVITIES

Record of Changes Affecting Sales and Distribution Together with Trade Personals and Notes on Foreign Trade, Jobbers' News and New Trade Literature

THE IDEAL ELECTRIC & MANUFACTURING COMPANY, 153 East Fifth Street, Mansfield, Ohio, has awarded contract for construction of a one-story, 160 ft. x 450 ft. and 100 ft. x 620 ft. factory building and a two-story, 35 ft. x 75 ft. office building, to cost about $350,000.

THE EAGER ELECTRIC COMPANY, Watertown, N. Y., manufacturer of generators, motors, etc., is planning to erect a one-story foundry in connection with its plant.

THE UNITED STATES ELECTRIC COMPANY, New London, Conn., has awarded contract for the construction of a one-story addition, 75 ft. x 100 ft., to its plant at Fort Trumbull, to be equipped for the manufacture of electric riveting and heating machines. Improvements will also be made to a number of existing buildings at the plant. The cost of the work is estimated at about $50,000.

THE PIONEER ELECTRIC SERVICE CORPORATION, Brooklyn, has filed notice of increase in capital stock from $20,000 to $120,000.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has acquired about twenty acres on Elmwood Avenue between Sixty-eighth and Seventieth Streets, Philadelphia, as a site for its proposed new plant. The company, it is understood, will begin work early in the fall on the new works, to cost including equipment about $10,000,000.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, has established a general service station at 501 Broadway, Milwaukee, Wis., in charge of S. B. Moyer. The sales office in the First Wisconsin National Bank Building, Milwaukee, under the management of F. T. Coup, will be continued.

THE WATSON-STILLMAN COMPANY, New York City, announces several changes in the board of directors of the company due to the retirement of A. F. Stillman from active interest in the management. Mr. Stillman remains as president of the company and also has full supervision of the sales. Carl Wigtel, chief engineer, was elected vice-president; A. Parker Nevin, secretary; W. H. Martin, purchasing agent. Mr. Wigtel has started on a ten weeks' trip to the Scandinavian countries, England, France, Belgium and Holland. While he is going mainly for a vacation, he will also investigate new development in the line of hydraulic machinery in all of the above countries. Mr. Wigtel has been connected with the company for thirty-three years.

THE MERMAID DISH WASHER COMPANY, Hartford, Conn., has recently been organized with a capital stock of $150,000 to take over the property and holdings of the Wolcott Manufacturing Company, manufacturer of dish-washing machines for household purposes. Frank E. Wolcott is president and general manager, and S. C. Stivers is vice-president, secretary and treasurer.

THE NAZEL ENGINEERING & MACHINE WORKS, 4041 North Fifth Street, Philadelphia, announces that the character of its business has been changed from that of an individual to a corporation. Ralph W. Nazel is president.

THE WORTHINGTON PUMP & MACHINERY CORPORATION, 115 Broadway, New York, announces the purchase from the Platt Iron Works, Dayton, Ohio, of their drawings, patterns, jigs, templates, special tools, good will and name on the following lines of product: Oil-mill machinery, hydraulic turbine and waterwheel line, feed-water heaters and high-pressure air compressors.

THE MUTUAL ELECTRIC & MACHINE COMPANY, manufacturer of switches, switchboards, etc., held its semi-annual sales conference at the main office, Detroit, on May 26, 27, 28 and 29. The time of the conference was divided between a discussion of the company's products, the company's inside organization and its selling plans and policies.

WM. G. MEROWIT, Buffalo, N. Y., in addition to the lines mentioned in the June 19 issue of the ELECTRICAL WORLD, handles the products of the Roller-Smith Company, New York City.

WILLSON GOGGLES, INC., Reading, Pa., formerly T. A. Willson & Company, has established offices in the Bush Terminal Building in New York City and the Magee Building in Pittsburgh, Pa., besides offices in Rio de Janeiro and Buenos Aires and an agency in Sydney, Australia.

THE PITTSBURGH GAGE & SUPPLY COMPANY, Thirtieth and Liberty Streets, Pittsburgh, manufacturer of electrically operated washing machines, etc., has made arrangements for an increase in capital stock from $750,000 to $2,500,000.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, East Pittsburgh, Pa., has taken a lease of four floors, providing about 50,000 sq.ft. of floor space, in the building being erected at Third and Elm Streets, Pittsburgh, Pa.

THE LIBERTY INCANDESCENT SUPPLY COMPANY has been organized with a capital stock of $30,000 by Joseph Klein, 241 South Atlantic Avenue, Pittsburgh, to manufacture incandescent electric lamps and other specialties.

THE ELECTRIC CONTROLLER & MANUFACTURING COMPANY, Cleveland, Ohio, has opened a new office at 208 North Broadway, St. Louis, Mo., in charge of R. J. Ehrhart.

THE AMERICAN INSULATOR COMPANY, New Freedom, Pa., with sales offices at 30 Church Street, New York City, and Detroit, Mich., announces the opening of another factory at Norwalk, Conn., in addition to expansion in production capacity at New Freedom, to meet the requirements of its rapidly increasing business.

THE COOLEY & MARVIN COMPANY, engineer, Tremont Building, Boston, is circulating a booklet entitled "Build for the Present and the Future," in which it calls attention to features to be considered in the construction of industrial plants.

THE SAFETY ELECTRIC COMPANY, Chicago, has removed its Chicago office from 537 North Dearborn Street to 431 South Dearborn Street. The new factory of the company at Des Plaines, Ill., has been put in operation.

THE HABIRSHAW ELECTRIC CABLE COMPANY, 10 East Forty-third Stret, New York City, is planning an extension, 60 ft. x 100 ft., one story, to its plant at Glenwood, Yonkers, N. Y., to cost about $30,000.

P. D. GIBSON, 2401 Eastern Avenue, Baltimore, Md., is planning to equip a plant for the manufacture of dish-washing machinery.

THE CIRCLE WASHER COMPANY, Belleville, N. J., contemplates the erection of a new plant, 100 ft. x 100 ft., to cost about $25,000.

THE ALLENTOWN CABLE & MACHINE COMPANY, Allentown, Pa., is asking for bids for the construction of a one-story building, 50 ft. x 100 ft., at Hamilton, to cost about $35,000.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has started work on an addition to its plant, recently acquired, in Hudson, N. Y.

THE STEINMETZ ELECTRIC MOTOR CAR CORPORATION, Baltimore, Md., has acquired property held by Reus Brothers on Mount Royal Avenue, Arlington, as a site for its proposed plant. Work will start immediately on installing machinery and equipment for the manufacture of electrically operated trucks and delivery cars.

WESTINGHOUSE, CHURCH, KERR & COMPANY, INC., is the name which will be used to designate the merger of Dwight P. Robinson & Company with Westinghouse, Church, Kerr & Company when that merger is complete.

THE DIFFERENTIAL CAR COMPANY, New York City, has purchased from the United States government the plant formerly operated by the Grant Motor Company, Findlay, Ohio, for the manufacture of munitions. The company, it is understood, will equip the plant for the manufacture of electrically operated dumping cars, dumping bodies for motor trucks, etc.

THE HOME ELECTRIC APPLIANCE COMPANY, Pittsburgh, Pa., is considering building an addition to its plant. The company recently increased its capital stock from $50,000 to $250,000.

THE HARRIS-WARREN ELECTRICAL CONSTRUCTION COMPANY, Manchester, Conn., has recently been organized by A. A. Warren and W. R. Harris. The company has opened an office in the Ferris Building on Oak Street and will do all kinds of electrical construction work.

THE BUCKEYE ELECTRIC CONSTRUCTION COMPANY, Dover, Ohio, recently organized, will do an electrical construction business and deal in electrical apparatus and supplies. The company plans to open a branch office in New Philadelphia, Ohio, in the near future. J. H. Geyer is president and general manager; John Thompson is vice-president; J. D. Crisel, 326 North Seventh Street, New Philadelphia, Ohio, is secretary and treasurer.

THE MORGANITE BRUSH COMPANY, Inc., 519-523 West Thirty-eighth Street, New York City, has been organized to take over the business and property of the Morgan Crucible Company.

THE UNDERFEED STOKERS COMPANY OF AMERICA, Chicago, has filed notice of an increase in capital stock from $1,000,000 to $1,250,000.

THE GRANITE CITY ELECTRIC COMPANY, 21 Fifth Avenue, St. Cloud, Minn., has recently been incorporated to deal in electrical devices and supplies and also to repair and rewind motors and generators. William C. Johnson is president and business manager.

THE WESTINGHOUSE ELECTRIC INTERNATIONAL COMPANY, East Pittsburgh, Pa., has made several appointments in its organization as follows: At East Pittsburgh, H. F. Griffith, assistant to general manager; R. W. Everson, manager of merchandising department, and H. C. Soule, manager of apparatus department. At New York: G. H. Bucher, assistant to general manager; J. H. Payne, supervisor of agencies, and F. M. Sammis, manager of incandescent-lamp department.

THE ELECTRIC TOOL MANUFACTURING COMPANY, Petersburg, Va., has purchased the business of the American Electric Tool Company, including patents, manufacturing equipment, good will, etc. The complete line of electric hammers will continue to be manufactured on a greatly increased scale. Louis Paulero will remain in charge as chief engineer.

THE VONDER KUHLEN ELECTRIC COMPANY, 3861 West Sixth Street, Los Angeles, Cal., successor to H. L. Vonder Kuhlen, electrical contractor, will do an electrical contracting business and will also deal in electrical appliances and supplies. H. L. Vonder Kuhlen is president and W. J. Barman is seretary and treasurer.

THE CAMPBELL ELECTRIC COMPANY, Lynn, Mass., expects to manufacture some new X-ray apparatus for the Foot-o'-Scope Corporation, which has just been incorporated with J. J. Lowe as president, Fred R. Campbell treasurer, and these two with Charles E. Campbell, president of the Campbell Electric Company, as board of directors.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, will hold a special meeting of the stockholders on July 9 to vote on the proposal to increase the capital stock of the company from $18,000,000 to $30,000,000, the proceeds to be used for the construction of a new plant and for other business requirements.

Supply Jobbers' Notes

THE GEORGE H. WAHN COMPANY, Boston, has been named as New England jobber for the entire line of electric heating appliances manufactured by the Manning-Bowman Company, Meriden, Conn. The Wahn company is now taking occupancy of the entire building at 69-71 High Street, Boston, and is enlarging its stockroom and office facilities.

Foreign Trade Notes

A. DWIGHT SMITH, district sales manager of the Northern Electric Company, Montreal, Que., Can., has been transferred to the general sales department at the head office. In his new position he will have charge of sales to railways, marine and shipbuilding concerns and fire-alarm systems in the Dominion of Canada. N. S. Richards, who has been sales manager at Calgary for the last three years, succeeds Mr. Smith as Montreal district sales manager.

THE EUGENE F. PHILLIPS ELECTRICAL WORKS, LTD., Montreal, Quebec, Can., are installing complete equipment for the manufacture of enameled wire.

INSULATED WIRES TO BE MANUFACTURED IN JAPAN.—Ten leading electric wire manufacturing concerns in Japan have recently issued a joint statement announcing that they have completed arrangements for the production of insulated wire to meet the official standards published in October, 1919. The manufacture of the old type of wires and cords will be discontinued.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

The representative of a company in Ireland (No. 33,109) is in the United States and desires to purchase or secure an agency for the sale in Great Britain, Syria, and Palestine of electrical household appliances, etc.

The representative in the United States of a merchant firm in South America (No. 33,120) desires to purchase and secure an agency for the sale in the River Platte countries of washing machines, electric household appliances, etc.

A company in Wales (No. 33,123) desires to purchase and secure an agency for the sale of electrical fittings, lamps, cables and accessories.

Trade Publications

LIFTING MAGNETS. — Publication 855 is being distributed by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., entitled "Lighting Magnets, Circular Type."

GOGGLES.—Willson Goggles, Inc., Reading, Pa., has issued a bulletin on its goggles for industrial use.

SAFETY DEVICES, ETC.—The Square D Company, Detroit, Mich., and Walkerville, Canada, has issued its new annual catalog, No. 25, showing the complete lines of safety devices, motor starters, etc.

TIME SWITCHES.—Bulletin No. 36 is being circulated by the Albert & J. M. Anderson Manufacturing Company, Boston, Mass., on automatic time switches.

HIGH-TENSION MAGNETOS. — The American Bosch Magneto Corporation, Springfield, Mass., has issued Catalogs Nos. 50, 58, 62, 66 and 2550 and advance 1920 catalog, covering its different types of high-tension magnetos and ignition systems.

ICE-MAKING AND REFRIGERATING PLANTS.—The Balsa Refrigerator Corporation, 149 West Thirty-sixth Street, New York City, successor to the Refrigidor Corporation, is circulating a booklet entitled "Why and How to Refrigerate," in which it describes the Frigidor electric ice-making and refrigerating plants.

TURBO-GENERATORS FOR STEAM LOCOMOTIVES.—Bulletin No. 105 issued by the Sunbeam Electric Manufacturing Company, Evansville, Ind., describes its type RE-3 500-watt, 32-volt turbo-generator for steam locomotives.

New Incorporations

THE MONTGOMERY ELECTRIC COMPANY, Clarksville, Tenn., has been incorporated with a capital stock of $10,000 by Robert McFarland, John E. Hensley, N. H. Spindler and Oscar G. Heinke.

THE WEST BETHEL LIGHT COMPANY, Bethel, Pa., has been chartered with a capital stock of $5,000 by J. L. Jordan, W. C. Bowers, C. W. Zollars, M. C. Bredwell and C. L. Bredwell.

THE LOCUST CENTER LIGHT COMPANY, Amelia, Ohio, has been incorporated with a capital stock of $2,500 by B. Belemeyer, W. C. Ayer, W. M. Eppert, A. R. Shapp, E. C. Meyer, F. E. Spiagel and J. D. Cross.

THE DALLAS (TEX.) ELEVATOR & ELECTRIC COMPANY has been incorporated with a capital stock of $35,000 by W. O. Parker, E. B. Thomas an A. C. Bookout.

THE OSAGE (IOWA) ELECTRIC LIGHT & HEAT COMPANY has been chartered with a capital stock of $75,000. James W. Ferris is president.

THE WHITE LAKE ELECTRIC LIGHT COMPANY, Weyauwega, Wis., has been incorporated by Edward F. Munsch, Fred Schoenick and William Kneip. The company is capitalized at $5,000 and proposes to furnish electricity for lamps, heaters and motors.

THE HYSIG COMPANY, Plainfield, N. J., has been incorporated by M. P. Stadele, G. E. Hudson and H. F. Hoffman, Plainfield. The company is capitalized at $20,000 and proposes to manufacture electric bells and other electrical apparatus.

THE BUCKEYE ELECTRIC COMPANY, Dover, Ohio, has been incorporated by C. Ripple, J. H. Geyer and L. Crissel. The company is capitalized at $10,000 and proposes to do a general electrical construction business and to deal in electrical appliances and supplies.

New England States

CHELSEA, MASS.—Contract has been awarded to J. Slotnik of Chelsea for an addition and alterations to the power plant at the Soldiers' Home.

LOWELL, MASS.—Business men and residents of the Davis Square section have had a petition presented to the City Council for the installation of a "white way" street-lighting system in that district.

TAUNTON, MASS.—The City Council has approved the appropriation of $400,000 for the purchase of a new unit for the municipal electric lighting plant. Prof. D. C. Jackson of the Massachusetts Institute of Technology has been retained to supervise the work.

ALBION, R. I.—Improvements to the street-lighting system in Lime Rock is under consideration.

PROVIDENCE, R. I.—Contract will soon be awarded by the Packard Motor Car Company, Broadway and Sixty-first Street, New York, N. Y., for the construction of a garage, service station, etc., to cost about $400,000. Electric light and power equipment will be required.

HARTFORD, CONN.—The capital stock of the Hartford River Company will be increased from $200,000 to $5,000,000 for the purpose of erecting a dam, 2,000 ft. long and 30 ft. high, at Windsor Locks, to develop 40,000 hp. for the transmission of electricity to serve Hartford and northern Connecticut. Harrison B. Freeman is secretary.

MONTVILLE, CONN.—The Robert Gair Paper Corporation will soon award contract for the construction of a manufacturing plant and power house, to cost about $500,000.

WATERBURY, CONN.—The Waterbury Clock Company, Cherry Street, contemplates the erection of a power house, to cost about $12,000.

Middle Atlantic States

ALBANY, N. Y.—The Wallkill Valley Electric Light & Power Company has been authorized by the Public Service Commission to make extensions to its electric plants in Montgomery and Wallkill.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

ALBANY, N. Y.—Bids will be received by the State Hospital Commission, Capitol, until July 7, for additional electric machinery, one 250-kva. engine-driven generator set and one 25-kw. motor-generator set, to cost about $10,000, at the Manhattan State Hospital. Drawings and specifications may be obtained from L. F. Pilcher, state architect, Department of Architecture, Capitol.

ALBANY, N. Y.—Bids will be received by the Trustees of Public Buildings, Executive Chamber, Capitol, until July 7, for electric work in the insurance department, Rooms 120 and 121, Capitol, to cost about $16,000. Drawings and specifications may be obtained from L. F. Pilcher, State Architect, Department of Architecture, Capitol.

ALBANY, N. Y.—Permission has been granted to R. L. Brown and G. R. Beckwith to construct and operate an electric plant in the towns of Taylor and Cincinnatus.

JAY, N. Y.—Application has been made by the Ausable Forks Electric Company to the Public Service Commission for permission to erect a local electric power plant.

LONG ISLAND CITY, N. Y.—Contract has been awarded to the White Construction Company, Inc., 95 Madison Avenue, by the Atlantic Macaroni Company, Inc., for the construction of a factory on Vernon Avenue and Fourteenth Street, to cost about $1,000,000.

LONG ISLAND CITY, N. Y.—The National Refining Company, Dock Street, has awarded contract to A. T. Woodruff & Sons, Bridge Plaza, for the construction of a power house to cost about $28,000.

WILMINGTON, N. Y.—The State Public Service Commission has granted authority to Frank E. Everest to construct a local electric light plant.

ATLANTIC CITY, N. J.—Contract has been awarded to the Thompson-Starrett Company, 49 Wall Street, New York, N. Y., by the Ritz-Carlton-Linnard Company, care of Warren & Wetmore, engineers and architects, 10 East Forty-seventh Street, New York, for the erection of a hotel, to cost about $2,000,000.

LAKEHURST, N. J.—Contract has been awarded to the Hughes-Foulkrod Company, Commonwealth Trust Building, Philadelphia, Pa., for the construction of power house, auxiliary building and barracks at the Naval Aircraft Station, to cost about $525,000.

NEWARK, N. J.—The Osborne Company, 759 Summer Avenue, is having plans prepared for the erection of a power house to cost about $50,000.

PASSAIC, N. J.—The Manhattan Rubber Company, Willett Street, contemplates the erection of a boiler, steam and electric power plant. Stone & Webster, 120 Broadway, New York, N. Y., are engineers.

TRENTON, N. J.—Bids will be received by the City Commission until July 16, for the furnishing of one 25,000,000 gal. centrifugal pump, motor and one 1,000-hp. steam turbine driven generator to be installed in the municipal waterworks. Alvin Bugbee is superintendent.

EASTON, PA.—The Eastern Pennsylvania Power Company of New Jersey has been granted authority to erect and maintain an overhead electric distribution system on certain grounds in Morris Park and on Morris Tunrpike.

PITTSBURGH, PA.—Plans are under way by the Gearless Motor Corporation, Flavel Street, for the construction of the initial unit of a new plant, to consist of a main works with adjoining structure, and a power house, to cost about $1,000,000, including equipment.

BALTIMORE, MD.—The installation of a number of 400-cp. electric lamps on St. Charles Avenue has been ordered by Lighting Superintendent Hanson.

BALTIMORE, MD. — Plans are being prepared by Edward H. Glidden, architect, American Building, for the erection of a high school, to cost about $600,000.

AMHERST, VA.—The installation of an electric lighting plant is under consideration.

North Central States

RIVER ROUGE, MICH.—The American Gypsum Company of Port Clinton, Ohio, will erect a local material storage and handling plant, to cost about $75,000. Electrically driven elevating and conveying equipment will be required. Louis Kamper, Book Building, Detroit, is engineer.

ST. JOHN'S, MICH.—Plans are under way for the erection of a municipal electric light and power plant, to cost about $250,000.

CLEVELAND, OHIO.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until July 15 for removing the present conduit, wiring and lighting fixtures and furnishing and installing a new conduit and wiring system and interior lighting fixtures in the United States Marine Hospital at Cleveland, Ohio. Drawings and specifications may be obtained at the Washington address.

DEFIANCE, OHIO. — Construction will be started at once on a modern electrically operated sugar factory for the Farmers' Sugar Company, Inc.

MARTINS FERRY, OHIO.—Plans are under way for the erection of a power plant to cost about $500,000. Herman Gamper, 219 New First National Bank Building, Columbus, Ohio, is consulting engineer.

MINERVA, OHIO.—Extensions and repairs to the municipal electric light plant, to cost about $50,000, are contemplated. H. Glass is village clerk.

TOLEDO, OHIO.—The De Vore Company, 908 Nicholas Building, contemplates the installation of electrically driven machinery in a new foundry, now under construction, to cost about $500,000.

TORONTO, OHIO. — The Follansbee Brothers Company of Pittsburgh, Pa., contemplates the erection of a power plant at its local works.

ZANESVILLE, OHIO.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until July 12, for additions and repairs to conduit and wiring, new lighting fixtures and furniture lighting in the United States Post Office. Drawings and specifications may be obtained at the above address or at the office of the custodian at Zanesville.

INDIANAPOLIS, IND.—Bids will be received at the office of the business director, Administration Building, Meriden and Ohio Streets, until July 8 for electric wiring in public schools Nos. 7 and 16. Plans and specifications are on file in the office of Snider & Rotz, 703 Merchants' Bank Building, Indianapolis.

WEST HAMMOND, IND.—Bids are being received by R. G. Pierce, architect, 10 South LaSalle Street, Chicago, Ill., for the erection of a steel plant for the La Salle Iron Works, to cost about $650,000, including equipment. Electrically operated machinery will be installed.

LEROY, ILL.—The Leroy Electric Light Company contemplates the erection of an electric transmission line to the village of Downs.

MANITOWOC, WIS.—The Public Utilities Commission contemplates the installation of an electric lighting system in Washington and Union Parks, to cost about $2,000.

ST. FRANCIS, WIS.—Work has been started on the construction of a power plant, to cost about $7,000,000, for the Milwaukee Electric Railway & Light Company, Public Service Building.

SHEBOYGAN, WIS. — The Board of Education will receive bids about July 15 for the erection of a high school, to cost about $750,000. Considerable electrical equipment will be required. Theodore Benefy is chairman.

WEST BEND, WIS.—The West Bend Heat & Light Company contemplates the erection of an electric power plant at West Bend and the extensions of its lines to Kohlsville, Newburg and Fredonia station, to cost between $80,000 and $100,000. The Combustion Engineering Company, 11 Broadway, New York, N. Y., is engineer.

PIPESTONE, MINN.—Bids will be received by S. W. Funk, city clerk, until July 15 for the establishment of a waterworks system to include an electric pumping plant.

DUBUQUE, IOWA.—The city officials contemplate the erection of a municipal electric light plant, to cost about $500,000. S. Stuba is city clerk.

SIOUX FALLS, S. D.—The installation of a hydro-electric plant on the Missouri River, to cost about $16,000,000, is under consideration.

Southern States

MORGANTOWN, N. C.—Bids will be received by the Board of Alderman, Town Hall, until July 5 for the furnishing of one 50-hp., three-phase, 550-volt, 60-cycle motor direct-connected by flexible coupling to one three-stage centrifugal pump with capacity of 250 gal. per minute against a total working head of 400 ft., one automatic pressure-controlled starter with no-voltage release, one 3-hp., three-phase, 550-volt, 60-cycle motor, direct-connected to single-stage centrifugal pump with capacity of 150 gal. per minute against a total working head of 25 ft., and one automatic switch controlled by float device.

MOUNT HOLLY, N. C.—The Blue Ridge Development Company, Inc., has been granted a charter to erect an electric distribution line from Mount Holly to Blowing Rock.

GREENVILLE, S. C.—The Cyclone Starter & Truck Company has awarded general contract to H. H. Ferguson, 6507 Euclid Avenue, Cleveland, Ohio, for the erection of a factory and power plant to cost about $125,000.

LANCASTER, S. C.—An issue of $45,000 in bonds is under consideration for the purchase and installation of an electric light plant in Lancaster.

SALUDA, S. C.—The Blue Ridge Power Company contemplates the installation of an additional hydro-electric unit, rated at 4,000 hp., which will increase development to 12,000 hp. W. S. Montgomery, of Spartanburg, is president.

DAVISBORO, GA.—Bonds to the amount of $15,000 have been voted for the erection of a local electric light plant.

MEMPHIS, TENN.—The Dixie Rubber Company, 770 Randolph Building, contemplates the erection of a power house to be used in connection with the proposed new works, to cost about $175,000.

SMITHVILLE, TENN.—The citizens of Smithville are contemplating the construction and equipping of an electric plant and the erection of a line from the Great Falls Power Company's plant at Rock Island, to Smithville, at a cost of about $30,000.

GADSDEN, ALA.—The Alabama Power Company, it is understood, will soon begin construction on a $5,000,000 power plant at Duncan's Riffle on the Coosa River. A dam 72 ft. high will be erected to develop between 90,000 hp. and 105,000 hp.

SHUBUTA, MISS.—An election will be held on July 13 for the purpose of submitting to the voters a proposition to issue $12,000 in bonds for the erection of an electric light plant.

OILTON, OKLA.—Plans are under way for the installation of a "white way" street-lighting system on various streets of the city.

Pacific Mountain States

GRANDVIEW, WASH.—The Pacific Power & Light Company contemplates the erection of a local substation.

SEATTLE, WASH.—Preliminary work has been started on the Gorge River project, which consists of the erection of a dam across the Skagit River, a tunnel to conduct water through the mountain to the proposed power plant, 2 miles away, and a power house to generate 50,000 hp. Plans necessitate the construction of a railroad 26 miles long and a 3,000-hp. unit to generate electric current at the temporary power and construction plant on Newhalem Creek. The cost of the project is estimated at about $7,000,000.

MALIN, ORE.—The installation of a municipal electric light and power plant is under consideration.

PORTLAND, ORE. — Plans are under way by the Elks' Lodge for the construction of a temple on Eleventh and Adler Streets, to cost about $700,000. Separate bids will be received on lighting, heating, etc.

EUREKA, CAL.—H. L. Jackman has been granted permission to divert 9,000 cu.ft. from the Klamath River, Humboldt County, for power purposes. The amount to be stored aggregates 150,000 acre-ft. The cost of the project is estimated at about $20,000,000, to include a steel pipe line and the erection of a dam.

SAN FRANCISCO, CAL. — Application has been made to the State Railroad Commission for permission to purchase the property of the California Power & Manufacturing Company of Fall River Mills by the Mount Shasta Power Company, an extension of the Pacific Gas & Electric Company. The cost is estimated at about $110,000.

HAVRE, MONT.—The Pacific Coast Fire Prevention Bureau has advised the installation of a fire-alarm system in Havre.

GREELEY, COL. — The Home Gas & Electric Company has made arrangements for the purchase of the property of the Farmers' Electric & Power Company of Eaton and the pumping plants of the Great Western Sugar Company.

EUREKA, NEV.—Petition has been circulated by W. H. Supp, representative of the Eureka Light, Heat & Power Company asking permission of the Board of County Commissioners to grant a franchise to locate and operate a local electric light, heat and power plant.

Canada

VIRDEN, MAN.—Bids will be received by the chief engineer, Manitoba Power Commission, New Parliament Buildings, until July 7 for the erection of a power house at Virden. Separate bids will also be received for two semi-Diesel engines for direct connection to alternating-current generator and two three-phase, 2,300-volt generators and switching equipment.

ALEXANDRIA, ONT.—The installation of a local electrically driven pumping plant is contemplated; and energy is to be furnished by the Hydro-Electric Power Commission of Ontario. Major Palmer is in charge.

HAMILTON, ONT.—Bids will soon be received for the construction of a steam auxiliary plant of the hydro-electric system.

KITCHENER, ONT.—In connection with the erection of a proposed motion-picture theater, to cost about $350,000, the Lasky Film Corporation, King Street, contemplates the installation of an electrically operated mechanical ventilation system, blower and electric motor, heating coils, electrical switchboard and lanterns.

LUDBURY, ONT.—The Board of Education has awarded contract to Sherwood & Sherwood, Harbor Building, Toronto, for the erection of a mining school, to cost about $250,000. An electrically operated ventilation system and electric light equipment will be installed.

TORONTO, ONT.—The Board of Education contemplates the erection of a technical high school, to cost about $400,000. An electrically driven mechanical ventilation system and electrical laboratory equipment will be installed. Dr. McKay, Central Technical School, College Street, is in charge.

TORONTO, ONT.—The Ontario Hydro-Electric Power Commission contemplates the purchase of the Niagara, St. Catharines & Toronto Railway, the Toronto Suburban Railway and the Eastern Railway and plans extensions.

WALKERVILLE, ONT. — General contract has been awarded by Hiram Walker's Sons to R. Westcott & Company, Sheppard Street, Windsor, for the construction of a power plant, to cost about $175,000.

SHAWINIGAN FALLS, QUE.—Arrangements have been made by the Shawinigan Water & Power Company for the issue of $4,000,000 in bonds, proceeds to be used for expansion and improvements, including the erection of a second transmission line from Shawinigan Falls to Montreal and the installation of a new 50,000-hp. unit at the local plant.

Miscellaneous

SANTIAGO, CUBA.—The power plant of the Santiago Electric Light, Railway & Power Company, it is reported, has been destroyed by fire, causing a loss of about $1,000,000.

ALABAMA LIGHT AND TRACTION ASSOCIATION. Secretary-treasurer, J. P. Ross, Birmingham Railway, Light & Power Co.

AMERICAN ASSOCIATION OF ENGINEERS. Secretary, C. E. Drayer, 63 East Adams St., Chicago, Ill. Annual convention, Buffalo, N. Y., May 10, 1921.

AMERICAN ELECTRIC RAILWAY ASSOCIATION. Secretary, E. B. Burritt, 8 West 40th St., New York City. Annual convention, Atlantic City, N. J., Oct. 11-15.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Prof. J. W. Richards, Lehigh University, Bethlehem, Pa. Annual meeting, Cleveland, Ohio, Sept. 30-Oct. 2.

AMERICAN INSTITUTE OF CONSULTING ENGINEERS, INC. Secretary, F. A. Molitor, 35 Nassau St., New York City.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, F. L. Hutchinson, 33 West 39th St., New York City. Board of directors meets monthly. Sections and branches in the principal electrical centers throughout the country. Annual convention, White Sulphur Springs, W. Va., June 29-July 2.

AMERICAN PHYSICAL SOCIETY. Secretary, Dayton C. Miller, Case School of Applied Science, Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS. Secretary-treasurer, C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

AMERICAN WELDING SOCIETY. Secretary, H. C. Forbes, 29 W. 39th St., New York City.

ARKANSAS UTILITIES ASSOCIATION. Secretary, S. E. Dillon, Hot Springs, Ark.

ASSOCIATED MANUFACTURERS OF ELECTRICAL SUPPLIES. General secretary, C. E. Dustin, 30 East 42d St., New York City.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, Preston S. Millar, Electrical Testing Laboratories, New York City.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. Secretary, John F. Kelly, Empire Building, Pittsburgh, Pa.

ASSOCIATION OF MUNICIPAL ELECTRICAL UTILITIES OF ONTARIO. Secretary, S. R. A. Clement, 190 University Ave., Toronto.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS. Secretary-treasurer, Joseph A. Andreucetti, Chicago & Northwestern Railway, Chicago, Ill. Annual meeting, Chicago, Ill., Oct. 28-31.

BRITISH COLUMBIA ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS. Secretary-treasurer, Capt. W. J. Conway, 406 Yorkshire Building, Vancouver, B. C. Annual meeting, Vancouver, B. C., Oct. 19.

CANADIAN ELECTRICAL ASSOCIATION, affiliated with N. E. L. A. Secretary-treasurer, Eugene Vinet, Shawinigan Water & Power Co., Montreal, Canada.

COLORADO ELECTRIC LIGHT, POWER AND RAILWAY ASSOCIATION. Secretary-treasurer, F. O. Safford, Denver Gas & Electric Co., Denver, Col. Annual convention, Glenwood Springs, Col., September.

CONFERENCE CLUB. Secretary, Sullivan W. Jones, 19 West 44th St., New York City.

COMMERCIAL SECTION, N. E. L. A. Secretary, R. H. Tillman, Baltimore, Md.

EASTERN NEW YORK SECTION, N. E. L. A. Secretary, J. L. Hemphill, General Electric Co., Schenectady, N. Y.

ELECTRIC HOIST MANUFACTURERS' ASSOCIATION. Secretary-Treasurer, E. Donald Tolles, 52 Broadway, New York City.

ELECTRIC FURNACE ASSOCIATION. Secretary, Dr. C. G. Schluederberg, Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

ELECTRICAL MANUFACTURERS' CLUB. Secretary, F. L. Bishop, Hartford Faience Co., Hartford, Conn.

ELECTRICAL SAFETY COUNCIL. Secretary, Dana Pierce, 25 City Hall Place, New York City.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION. General secretary, Franklin Overbaugh, 411 South Clinton St., Chicago, Ill.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION, ATLANTIC DIVISION. Secretary, E. Donald Tolles, 52 Broadway, New York City.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION, PACIFIC COAST DIVISION. Secretary, Albert H. Elliot, 502 Flatiron Building, San Francisco, Cal.

ELECTRICAL TRADE ASSOCIATION OF CANADA. Secretary, William R. Stavely, Royal Insurance Building, Montreal, Canada.

Directory of Electrical Associations

Printed in the First Issue of Each Month

ELECTRIC POWER CLUB. Secretary, C. H. Roth, 1410 West Adams St., Chicago, Ill.

EMPIRE STATE GAS AND ELECTRICAL ASSOCIATION. Secretary, Charles H. B. Chapin, Grand Central Terminal Building, New York City.

FLORIDA ENGINEERING SOCIETY. Secretary, J. R. Benton, Gainesville, Fla.

ILLINOIS STATE ELECTRIC ASSOCIATION. Secretary-treasurer, R. V. Prather, Springfield, Ill.

ILLUMINATING ENGINEERING SOCIETY. General secretary, Clarence L. Law. Sections in New York, Philadelphia, Pittsburgh, Cleveland, Chicago and Boston. Annual convention, Cleveland, Sept. 27, 28, 29 and 30.

INDIANA ELECTRIC LIGHT ASSOCIATION. Secretary, Thomas Donohue, Lafayette, Ind. Annual convention, Sept. 15-17, French Lick, Ind.

INDUSTRIAL ELECTRIC HEATING ASSOCIATION. Secretary, Homer Kunz, Toledo Railways & Light Co., Toledo, Ohio.

INSTITUTE OF RADIO ENGINEERS. Secretary, Alfred N. Goldsmith, College City of New York, New York.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, C. R. George, Houston Tex.

INTERNATIONAL ELECTROTECHNICAL COMMISSION (international body representing various national electrical engineering societies contributing to its support). General secretary, C. le Maistre, 28 Victoria Street, Westminster, London, S. W., England.

IOWA SECTION, N. E. L. A. Secretary-treasurer, M. G. Linn, Des Moines, Iowa.

JOVIAN ORDER. Jupiter (president), Arthur J. Binz, Houston, Tex.

KANSAS PUBLIC SERVICE ASSOCIATION. Secretary-treasurer, W. W. Austin, Cottonwood Falls, Kan.

MICHIGAN SECTION, N. E. L. A. Secretary, Herbert Silvester, Ann Arbor, Mich. Annual convention, Ottawa Beach, Mich., Aug. 24-26.

MISSISSIPPI ELECTRIC ASSOCIATION, affiliated with the N. E. L. A. Secretary, E. S. Myers, Vicksburg, Miss.

MISSOURI ASSOCIATION OF PUBLIC UTILITIES. Secretary-treasurer, F. D. Beardslee, 315 N. 12th St., St. Louis, Mo.

NATIONAL ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS. Secretary, W. H. Morton, 110 West 40th St., New York City, N. Y. State associations in Alabama, Arkansas, Connecticut, Georgia, Kansas, Illinois, Indiana, Iowa, Louisiana, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Jersey, New York, Ohio, Oregon, Pennsylvania, Tennessee and Wisconsin. Annual convention, Baltimore, Md., Oct. 4-8.

NATIONAL COUNCIL OF LIGHTING FIXTURE MANUFACTURERS. Secretary, C. W. Hoffrichter, 8410 Lake Ave., Cleveland, Ohio.

NATIONAL ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary-treasurer, William L. Smith, Northeastern College, Boston, Mass.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Executive assistant to president, M. H. Aylesworth, 29 West 39th St., New York City.

NATIONAL ELECTRICAL CREDIT ASSOCIATION. Secretary, Frederic P. Vose, 1350 Marquette Building, Chicago, Ill.

NATIONAL FIRE PROTECTION ASSOCIATION. Secretary of electrical committee, Ralph Sweetland, 141 Milk St., Boston, Mass.

NEBRASKA SECTION, N. E. L. A. Secretary-treasurer, B. H. Conlee, Nebraska Gas & Electric Co., Beatrice, Neb.

NEW ENGLAND ELECTRICAL CREDIT ASSOCIATION. Secretary, Alton F. Tupper, 15 State St., Boston, Mass.

NEW ENGLAND GEOGRAPHIC DIVISION, N. E. L. A. Secretary, Miss O. A. Bursiel, 149 Tremont St., Boston, Mass. Annual convention, Kineo, Me., Sept. 14-16.

NEW MEXICO ELECTRICAL ASSOCIATION. Secretary-treasurer, Charles E. Twogood, Albuquerque, N. M.

NEW YORK ELECTRICAL CREDIT ASSOCIATION. Secretary, E. Donald Tolles, 52 Broadway, New York City.

NEW YORK ELECTRICAL SOCIETY. Secretary, George H. Guy, 29 West 39th St., New York City.

NORTH CENTRAL ELECTRIC ASSOCIATION, N. E. L. A. Secretary, M. Barnett, St. Paul, Minn.

NORTHWEST GEOGRAPHIC DIVISION, N. E. L. A. Secretary, L. A. Lewis, Washington Water Power Co., Spokane, Wash.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Annual meeting, Cedar Point, Ohio, July 13-16.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, Prof. F. E. Sanborn, Ohio State University, Columbus.

OKLAHOMA UTILITIES ASSOCIATION. Secretary, H. A. Lane, 611 State National Bank Building, Oklahoma City.

PACIFIC COAST GEOGRAPHIC DIVISION, N. E. L. A. Secretary, A. H. Halloran, Rialto Bldg., San Francisco, Cal.

PENNSYLVANIA ELECTRIC ASSOCIATION, State Section N. E. L. A. Secretary, H. M. Stine, 211 Locust St., Harrisburg, Pa. Annual convention, Bedford Springs, Pa., Sept. 8-11.

PUBLIC SERVICE ASSOCIATION OF VIRGINIA. Secretary, W. J. Kehl, Virginia Railway & Power Co., Richmond, Va.

PUBLIC UTILITIES ASSOCIATION OF WEST VIRGINIA. Secretary, W. C. Davisson, West Virginia Water & Electric Co., Charleston, W. Va.

RADIO CLUB OF AMERICA. Secretary, T. J. Styles, 1112 S. Curtis Ave., Richmond Hill, Queens Borough, N. Y.

ROCKY MOUNTAIN ASSOCIATION OF MUNICIPAL ELECTRICIANS. President, Lawrence Stone, Denver, Col.

SOCIETY FOR ELECTRICAL DEVELOPMENT, INC. General manager, J. M. Wakeman, Guaranty Building, 522 Fifth Ave., New York City.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Dean F. L. Bishop, University of Pittsburgh, Pittsburgh, Pa. Annual Meeting, Ann Arbor, Mich., June 29-July 2.

SOUTHEASTERN DIVISION, N. E. L. A. Secretary-treasurer, Charles A. Collier, Georgia Railway & Power Co., Atlanta, Ga. Annual convention Sept. 17-19, Asheville, N. C.

SOUTHERN CALIFORNIA ELECTRICAL CONTRACTORS AND DEALERS' ASSOCIATION. Secretary-treasurer, J. E. Wilson, 425 Consolidated Realty Building, Los Angeles, Cal.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION. Secretary, H. S. Cooper, 403-4 Slaughter Building, Dallas, Tex.

SOUTHWESTERN SOCIETY OF ENGINEERS. Secretary, C. E. Barglebaugh, 721 First National Bank Building, El Paso, Tex.

TECHNICAL SECTION, N. E. L. A. Secretary, W. C. Anderson, 29 West 39th St., New York City.

TORONTO ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, E. F. W. Salisbury, 615 Yonge St., Toronto, Ont.

TRI-STATE WATER AND LIGHT ASSOCIATION. Secretary-treasurer, W. F. Steiglitz, Columbia, S. C.

VERMONT ELECTRICAL ASSOCIATION. Secretary-treasurer, A. B. Marsden, Rutland, Vermont.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 175 West Jackson Blvd., Chicago, Ill.

WESTERN SOCIETY OF ENGINEERS, ELECTRICAL SECTION. Secretary, E. S. Nethercut, 1735 Monadnock Block, Chicago, Ill.

WISCONSIN ELECTRICAL ASSOCIATION. Secretary, J. P. Pulliam, 1408 First National

(Issued June 8, 1920)

1,342,478. ENGINE STARTER; Frank E. Watts, Detroit, Mich. App. filed Dec. 14, 1917. Mounted on flywheel case.

1,342,511. TERMINAL SEAL FOR STORAGE BATTERIES; McConnell Shank, Akron, Ohio. App. filed Feb. 10, 1919. Tightened by wedge.

1,342,546. MULTIPLE-UNIT SAFETY SWITCHBOARD; Hubert F. Krantz, Brooklyn, N. Y. App. filed Aug. 2, 1917. Removable switch units.

1,342,547. MULTIPLE-UNIT SAFETY SWITCHBOARD; Hubert F. Krantz, Brooklyn, N. Y. App. filed June 6, 1918. Has removable switch units.

1,342,548. SWITCH MECHANISM; Hubert F. Krantz, Brooklyn, N. Y. App. filed Aug. 2, 1917. Cannot operate when guard is set.

1,342,553. INTERNAL-COMBUSTION ENGINE; Frederick H. Leinweber, Chicago, Ill. App. filed Nov. 6, 1916. Several spark plugs in one cylinder.

1,342,579. TROLLEY SIGNAL; Joseph Bazil and Frank Giardi, Detroit, Mich. App. filed Feb. 17, 1919. Signals "Stop" to traffic behind.

1,342,581. TELEPHONE TRANSMITTER; William Birrell and James Birrell, Chicago, Ill. App. filed Aug. 18, 1917. Means for securing parts of transmitter diaphragm.

1,342,582. TELEPHONE TRANSMITTER; William Birrell and James Birrell, Chicago, Ill. App. filed June 27, 1916. Two relatively fixed electrodes vibrated in unison.

1,342,583. MOUNTING FOR DYNAMO BRUSHES; Henry E. Borger, Newark, N. J. App. filed Nov. 3, 1917. For motorcycles.

1,342,594. VARIABLE-RESISTANCE DEVICE; John Parkin, Jr., San Rafael, Cal. App. filed July 31, 1919. For rheostats and potentiometers.

1,342,607. IGNITION MAGNETO; John R. Stark, Racine, Wis. App. filed April 26, 1919. Good spark at low speed.

1,342,611. STORAGE-BATTERY SEPARATOR AND PROCESS OF PRODUCING SAME; Theodore A. Willard, Cleveland, Ohio. App. filed Oct. 5, 1917. Ribs securely attached to separator blanks and properly positioned.

1,342,636. ELECTROMETALLURGICAL FURNACE; François Louvrier, Paimbœuf, France. App. filed April 5, 1919. For reduction of zinc ore.

1,342,645. GROUNDING DEVICE; Charles W. Pen Dell, Chicago, Ill. App. filed Jan. 9, 1918. Grounding wire and cone of same material welded together.

1,342,658. ELECTRIC LIGHT SOCKET; Louis E. Wood, Farrell, Pa. App. filed Dec. 27, 1918. Ejector to force out bulb.

1,342,664. CONSTRUCTION OF BODIES OF MOTOR AND OTHER VEHICLES; Fernand M. Charles, Iver Heath, Eng. App. filed Feb. 26, 1919. Making curved shapes by electro-depositing.

1,342,717. PROCESS OF METAL WELDING; Evrah C. Lipps, Detroit, Mich. App. filed Nov. 9, 1917. By a series of spot welds.

1,342,729. SYNCHRONIZED AIRPLANE-GUN-CONTROL SYSTEM; Frank Wenner, Washington, D. C. App. filed Aug. 26, 1919. Gun fired between blades of rotating propeller.

1,342,737. METHOD OF RECOVERING BY-PRODUCTS FROM WASTE LIQUORS; George M. Bradford and James E. Broadhead, Bay City, Mich. App. filed Sept. 16, 1918. Recovering potash and other products as a by-product of sugar factories.

1,342,787. GRIP FITTING FOR ELECTRIC CORD; Ernest C. White, New York, N. Y. App. filed Aug. 26, 1918. Prevents strain on joints.

1,342,788. DIRECTION-INDICATING DEVICE; Thomas B. Wright, Chicago, Ill. App. filed May 14, 1917. For automobiles.

1,342,792. TELEPHONE SYSTEM; Leonard C. Bygrave and Thomas M. Inman, London, England. App. filed July 25, 1917. One thousand trunk-line groups.

1,342,797. SYSTEM OF MARINE PROPULSION; Angelo Conti, Washington, D. C. App. filed Dec. 9, 1915. Two motors for different speeds acting alternately as generators.

1,342,804. METALLURGICAL PROCESS; William E. Greenawalt, Denver, Col. App. filed Dec. 21, 1916. For copper refining.

1,342,809. METHOD FOR HEATING OF MATERIAL OR THE PERFORMANCE OF CHEMICAL PROCESSES IN ELECTRICAL FURNACES, TOGETHER WITH APPARATUS INTENDED THEREFOR; Torsten A. F. Holmgren, Stockholm, Sweden. App. filed July 24, 1919. Two pairs of electrodes or groups of electrodes.

Record of Electrical Patents

(Notes on United States Patents

1,342,816. SPARK GAP; Oren W. Kinley, Des Moines, Iowa. App. filed July 8, 1919. Between spark plug and service wires

1,342,819. CONNECTOR PLUG; Clair D. Lake, Endicott, N. Y. App. filed Jan. 15, 1919. Switchboard plug.

1,342,823. TELEPHONE-EXCHANGE SYSTEM; Alben E. Lundell and Edgar H. Clark, New York, N. Y. App. filed Nov. 2, 1917. Semi-automatic type for tandem trunking.

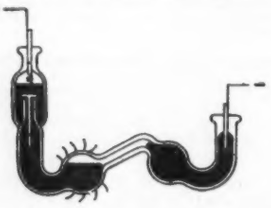
1,342,835. ELECTRICAL DETECTING MACHINE; Emery L. Welch, Lima, Ohio. App. filed Jan. 19, 1918. Prevents unauthorized interruption of telephone conversation.

1,342,837. IGNITION DEVICE; Robert N. Wood, Dallas, Tex. App. filed April 7, 1919. Test switch on spark plug.

1,342,842. RESISTANCE ELEMENT; Theodore W. Case, Scipo, N. Y. App. filed March 15, 1920. Varies with intensity of light to which element is exposed.

1,342,860. APPARATUS FOR FACILITATING THE LANDING OF AIRCRAFT; William Mortimer and Frederick Potten, Dover, Eng. App. filed May 13, 1919. Indicates at distance direction of wind.

1,342,864. ELECTRIC SADIRON; John P. Nionow, New York, N. Y. App. filed Aug. 6, 1919. Detachable heater.



1,343,037. Mercury-Vapor Lamp

1,342,885. METHOD OF RECEIVING HIGH-FREQUENCY OSCILLATIONS; Edwin H. Armstrong, Paris, France. App. filed Feb. 8, 1919. For waves of short length.

1,342,899. METAL-PLATING MACHINE; Charles W. Eddy, East Providence, R. I. App. filed April 29, 1919. Washing, plating and drying in one continuous operation.

1,342,902. TELEPHONE SYSTEM; Charles L. Goodrum, New York, N. Y. App. filed Sept. 14, 1917. For selective switching.

1,342,905. SWITCH ATTACHMENT FOR ELECTRIC IRONS; Charles H. Helling, Oakland, Cal. App. filed April 3, 1919. Automatic and manual operation.

1,342,910. PROCESS OF COLORING IRON OR STEEL ARTICLES; Herbert F. Jermain, N. H. App. filed Jan. 7, 1920. Coloring and rust-proofing.

1,342,915. ELECTRIC FEED MECHANISM FOR PLANERS AND CURRENT-CONTROLLING SYSTEM THEREFOR; Sven P. Johnson, Philadelphia, Pa. App. filed March 16, 1916. Automatic feed and cut off

1,342,940. CARRIAGE-RETURN MECHANISM FOR TYPEWRITERS; Franklin C. Breuckman and George T. Arnold, Mackinac Island, Mich. App. filed July 28, 1919. By solenoid.

1,342,944. COMBINED INCIDENCE AND SIDE-SLIP INDICATOR FOR AEROPLANES AND THE LIKE; Oscar A. Danielson, New York, N. Y. App. filed Sept. 30, 1916. Free from effects of gravitation.

1,342,952. STORAGE-BATTERY CONSTRUCTION; William Gardiner, Chicago, Ill. App. filed June 9, 1919. Improved separator.

1,342,953. ACTIVE MATERIAL FOR BATTERY PLATES; William Gardiner and William H. Duggan, Chicago, Ill. App. filed Aug. 23, 1919. No buckling.

1,342,954. COVER FOR STORAGE BATTERIES; William Gardiner, Chicago, Ill. App. filed Oct. 4, 1919. Means for permitting escape of gases.

1,342,957. METHOD OF RESISTANCE WELDING; James H. Gravell, Elkins Park, Pa. App. filed July 11, 1919. Butt-welding tubes, high-speed steel to low-carbon steel, and welding cast metal to wrought metal or steel.

1,342,995. ELECTRICAL APPARATUS; John J. Frank, Pittsfield, Mass. App. filed Sept. 2, 1919. Three-phase transformers and reactances.

1,343,018. PROTECTIVE DEVICE; Edmund B. Wedmore, Hendon, England. App. filed Oct. 24, 1919. Capacity current compensated for.

1,343,020. ENGINE-STARTING APPARATUS; Lionel M. Woolson, Detroit, Mich. App. filed June 20, 1919. Automatically engages and disengages.

1,343,021. CONTROLLER FOR ELECTRIC MOTORS; Paul H. Zimmer, Schenectady, N. Y. App. filed Jan. 8, 1919. For compensator starting.

1,343,022. STARTING DEVICE FOR ELECTRIC MOTORS; Paul H. Zimmer, Schenectady, N. Y. App. filed Jan. 25, 1919. By magnetic contactors.

1,343,026. ROTARY TRANSFORMER; Theophilus F. Barton, Schenectady, N. Y. App. filed May 27, 1919. Rotary converter with commutating poles.

1,343,028. ENGINE-STARTING APPARATUS; Joseph Bijur, New York, N. Y. App. filed May 5, 1913. Automatically disengaged on starting.

1,343,029. ENGINE-STARTING APPARATUS; Joseph Bijur, New York, N. Y. App. filed June 25, 1913. Automatically disengages after starting.

1,343,030. ENGINE-STARTING APPARATUS; Joseph Bijur, New York, N. Y. App. filed June 25, 1913. Automatically disengaged when engine starts.

1,343,037. MERCURY-VAPOR LAMP; Marie J. Cornu, Paris, France. App. filed Jan. 5, 1918. Arc of small length but high brilliancy.

1,343,053. FUEL VAPORIZER FOR COMBUSTION ENGINES; Chester G. Hedges, Chase, Kan. App. filed April 9, 1918. Applied to manifold of engine.

1,343,127. ELECTRICAL TOY GUN; Thomas Hallinan, Paterson, N. J. App. filed March 3, 1919. For rapid fire.

1,343,134. ELECTRIC WATER HEATER; William D. Huff, Lafayette, La. App. filed July 3, 1919. Delivers cold, warm or hot water.

1,343,141. ELECTRIC SIGN; Paul J. Kenagy, Newton, Kan. App. filed July 9, 1917. For medical advertising and demonstrating.

1,343,165. SUBMARINE RADIO SYSTEM; Peter E. Stogoff, New York, N. Y. App. filed Feb. 20, 1918. Under-water radio communication.

(Issued June 15, 1920)

1,343,194. ELECTRIC ARC-WELDING SYSTEM; Albert M. Candy, Wilkinsburg, Pa. App. filed Sept. 3, 1919. Prevents shock to operator.

1,343,196. SIGNALING SYSTEM; Roy D. Conway, Chatham, N. J. App. filed Sept. 21, 1918. Signals when circuit is energized.

1,343,199. ARC-WELDING SYSTEM; Otto H. Eschholz, Wilkinsburg, Pa. App. filed Sept. 8, 1919. Easy starting characteristics.

1,343,200. ARC-WELDING SYSTEM; Otto H. Eschholz, Wilkinsburg, Pa. App. filed Sept. 8, 1919. High starting voltage.

1,343,201. ARC-WELDING SYSTEM; Otto H. Eschholz, Wilkinsburg, Pa. App. filed Sept. 8, 1919. High starting voltage.

1,343,202. ELECTRIC ARC-WELDING SYSTEM; Otto H. Eschholz, Wilkinsburg, Pa. App. filed Sept. 8, 1919. High starting voltage.

1,343,203. ELECTRIC ARC-WELDING SYSTEM; Otto H. Eschholz, Wilkinsburg, Pa. App. filed Oct. 6, 1919. High voltage when operating.

1,343,204. ELECTRIC ARC-WELDING SYSTEM; Otto H. Eschholz, Wilkinsburg, Pa. App. filed Oct. 6, 1919. High voltage for starting.

1,343,205. ALTERNATING-CURRENT WELDING SYSTEM; Otto H. Eschholz, Wilkinsburg, Pa. App. filed Oct. 6, 1919. High starting voltage.

1,343,206. ELECTRIC ARC-WELDING SYSTEM; Otto H. Eschholz, Wilkinsburg, Pa. App. filed Oct. 11, 1919. High starting voltage.

1,343,207. ELECTRIC ARC-WELDING SYSTEM; Otto H. Eschholz, Wilkinsburg, Pa. App. filed Nov. 24, 1919. High voltage for starting.